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Vol. I, No. 4, December 1954 *Eugenics Quarterly*

EDITORIAL COMMENT

A Research Program for Qualitative Eugenics

If one surveys the mass of material on human heredity now being assembled and published (as, for example, in *The American Journal of Human Genetics*) one cannot but be impressed with the contrast between such material and the material with which we, as students of eugenics, are concerned. A variety of relatively simple attributes, handled in terms of the classical Mendelian conceptions, are described in the pages of modern "medical genetics,"—or rather we might properly say "anthropological genetics"—the genetics of simple and easily identifiable human characteristics. Many of the characteristics are anatomical, but there is occasionally some concern with functional units when these also can be treated in Mendelian fashion. The geneticist, as a hard-boiled scientist, is concerned with the identification of characteristics which can be handled in classical terms. He is, to be sure, ready to emphasize the fact that many genes may combine in the determination of a phenotype; that a gene may play its role in partial determination of many phenotypic characteristics; and that the problems of physiological genetics are far beyond the possibility of any easy solution. Nevertheless, the geneticist has made his choice as a scientist, to begin with *simple* things and to work simple concepts as far as he can work them, rather than giving his primary attention to intangibles, to complexities, and to challenges which the method of science is not equipped to answer.

It is exactly these last issues—these issues that have to do with the complexities of human peronality, difficult to define and baffling to conceptualize in terms of research—that constitute the central problems of eugenics. *Can we formulate eugenic problems so that genetics research can cope with them?*

Take, for example, the now classical problem of the "inheritance of intelligence," with which students of eugenics have been concerned for decades and with reference to which literally hundreds of papers have battled their way through the "nature-nurture" problem. This is, in fact, the main qualitative problem of human heredity upon which research data have been accumulated. How is the problem of the inheritance of intelligence to be brought into relation to what is known about human genetics? Only by postulating a very large number of genes, the dominance relationships of which are unknown; by postulating very complex interdependence among these genes in relation to the development of the central nervous system; by conceding a very subtle, continuous and important influence of environmental factors upon the development of the central nervous system, guided by these genetic contributions; and by defining quantitatively a way in which the genetic contributions may be compared with those due to variance in environmental factors. Psychologists must face these complexities when they discuss eugenics.

About twenty-five years ago the study of inheritance of intelligence seemed on the way to achieve some considerable success, especially through the California Study by Barbara Burks and the Illinois Study by Frank Freeman and his collaborators, appearing simultaneously in the Yearbook of the National Society for the Study of Education in 1928. Here, while taking different positions with respect to the role of heredity, the investigators agreed that a quantitative problem regarding the contri-

butions of nature and nurture could be defined, and that a fairly accurate quantitative answer could be secured.

Since that time a number of things have happened to cast doubt on the adequacy of this approach. First it has been documented now, beyond any reasonable doubt, as Thorndike long ago noted, that "intelligence is not homogeneous." Developmental and factorial studies indicate many different types of competence in dealing with environmental difficulties. They show, moreover, as Wechsler among others pointed out, that "non-intellectual" factors are important components in "intellectual" achievements; that the learning process, which is supposed to be the key to the intellectual gift, is itself a highly complex, and by no means well-understood phenomenon; and that even the simplest cognitive functions, such as perception and recall, lend themselves very badly indeed to conceptualization in terms of the units with which the student of heredity deals. Psychologists and social scientists must work for data which are genetically meaningful. I heard one paper this year at the meetings of the American Psychological Association that brought measurement into relation to basic genetics theory. It was refreshing.

It is true to say, as George Klein and his collaborators have said, that there are deep-seated and fundamental differences in "cognitive style" between persons; but when it comes to defining what is meant by "deep-seated," or where the genetic contribution comes in, we are in the dark. In the entire realm of qualitative differences between human beings we need basic research. We have not, today, even a clear conceptual scheme as to the structure of intelligence; and certainly no clear ideas as to how the genetic and environmental factors cooperate in the development of each specific type of intelligence and the interaction between such types. The result of this whole train of thought is to make it difficult indeed to specify just what is meant by the "inheritance of intelligence" and how a eugenics program could even be formulated which would work toward such a goal. All quite aside from the question of making clear to the public and to legislators what the issues are and how they can be resolved. If the scientist himself is ignorant, he can hardly expect a public to be much concerned with his program.

It might well be maintained by the more sensitive and socially-minded students of such matters that the position taken here is somewhat too nihilistic. Are there not many cases in which we *can* work toward a social goal with energy and devotion, without knowing very clearly what the achievement of the goal will mean and what the exact steps to be taken are? Is it not possible to block out in a rough general way the difference between competence and incompetence? Do we not have our Einsteins and our mental defectives? Can we not in a gross way produce by negative eugenics the elimination of the grossly unfit, and by positive eugenics the furthering of higher reproduction rates among the most gifted?

The reply to this question, I believe, is to note the three main areas in which a eugenics program has in general been conceived over the period of the last century. First, in terms of the furthering of higher reproduction rates among superior *races;* second, the furthering of higher reproduction rates among superior *occupational groups;* third, the furthering of higher reproduction rates among favored families within each component social group. It is now generally admitted that the racialist argument has completely collapsed. The recent work on occupational differences has whittled down more and more the presumed innate differences between occupational groups, until the University of Chicago studies centered in the work of Davis, Eels, and Haggard, have indicated that under true standardization of test methods, which are comparable for all occupational groups, the difference between occupation-

al groups is small and hard to interpret. This leaves the eugenics case centered mainly in the matter of individual differences *within* defined social groups.

How much better off is eugenics now? Certainly *somewhat* better off, because the enormous individual differences among the progency of a given pair do make sense in terms of genetic theory, and we may assume that families therefore differ genetically not only in anatomical but in functional characteristics.

But what are the tools with which we should go to work to identify the *genetic facts* upon which such individual differences within the family are founded? Parent-child resemblances appear in "general intelligence," in "special abilities," in sensitivity for certain aspects of the environment, and in "personality." Studies of children early separated from their true parents and of identical twins reared apart suggest that psychological parent-child resemblance is to *some* degree dependent upon a genetic contribution. If this statement sounds excessively vague, the challenge comes: *how can it be made more specific? It is hard to think of a single aspect of psychological inheritance which is definite enough to permit the formation of a eugenics program.*

We inevitably fall back here upon the fact of general correlation among desirable attributes, assuming—in the long run—that those who are intellectually gifted are also gifted in terms of sensitivity, creativeness, appreciation of the attributes of others, impulse control, and other socially desirable attributes. These attributes are, moreover, socially linked in various ways, at least from the point of view of those members of favored groups who themselves constitute the research theorists and research personnel. Whether they are genetically linked in the true sense is unknown and unknowable at present. They are "associated" in the same sense in which the geneticist uses the term, but this means that under different conditions of mating, arising from social changes, the association might well disappear. It is difficult to come to any confident conclusion as to what one can do with a positive eugenics program except to note that in our society the traits which make for social effectiveness tend, in a rough general way, to go together, and to note, as Osborn has very wisely done, that genetic and environmental factors appear likely in the long run to work together, the constitutionally favored tending to be those who provide the socially more desirable environments for their progeny. This conception that eugenic and euthenic programs go together, rather than competing, is fundamental. It leaves us, however, without any rationale for a eugenics program organized around the *furtherance of hereditary strains which are intrinsically "better"*—in any sense in which the theorist wishes to use the term.

Furthermore no large *research program in human genetics which is relevant to eugenics* is yet under way. The purpose of this editorial is to point out the desperate need *to begin thinking about such a program.* Its aim is to plead with social scientists, medical men, community leaders, and all who are concerned with the long-range happiness of mankind, to recognize that research will have to be focused for a long time upon basic issues in human genetics, not limited to simple Mendelian conceptions about single genes but concerned much more with the intricate process by which the more complex and fundamental social attributes are derived. This will mean not only great caution in making claims as to the way in which phenotypic social characteristics are related to genotypic characteristics, but very great humility in defining the various kinds of competence and various kinds of emotional and impulsive characteristics upon which careful genetics research could be carried out. *If our recognition of our ignorance is explicit, the students of human genetics will more and more tend to work with us.* Some of them, just about to do a beautiful study of tooth and bone deformation based on

elaborate pedigree charts, may even begin to plan research on neural and biochemical factors related to human personality. Maybe we can work with them. If our recognition of our ignorance about the interaction of genetic and environmental factors is explicit, most social scientists, who today are regarded as hopelessly committed to a naive view of heredity, will begin likewise to work with us. If once it is clear that we are not only intellectually honest enough to recognize that we do not have a factual basis for a genetic program, but that *we are concerned today primarily with the question of finding out how to go about studying the more basic individual differences among human beings,* we shall find ourselves, I believe, very soon in the possession of a much larger group of understanding friends with whom we can communicate.

My plea then is for a genuine research program into a qualitative human genetics, in which there will be a frontal attack upon the problem of parent-child resemblance and other types of data which could help us to understand the more complex social attributes. This means the continuation of the types of statistical work already going on in parent-child, sib-sib, twin-twin resemblance, etc. But it will mean also the development of a group of definite hypotheses about human genetics which will be intelligible to, and can be improved by, the human geneticist, constituting a long-range research program both for deeper understanding and for practical results, at the some time working hand in hand with the social scientists in the development of hypotheses showing the relationships between human genetic attributes and various types of cultural factors in human development. When once a research program is established on a broad basis which can command the respect of both the biologically oriented and the socially oriented, we shall no longer need to plead simply for the improvement of better stocks but can formulate something specific about the conditions under which specific desirable attributes might be encouraged and ways in which the hypotheses can be tested by fresh data. If we could give both the expert world and the public a series of tested hypotheses, the results of which unambiguously show certain trends in human genetics now at work in society which are undubitably of great importance, we shall have done our major research job.

The rest would be an educational job in which likewise we could have a part. We cannot, however, do our immense educational job without first pointing to a series of significant and established principles which are of direct relevance to the problem of genetic trends at work which are actually producing demonstrable psychological and social trends. When such facts are at hand, they will begin more and more to have their deep impact. It is only the enormous importance of the facts about changes going on in the human stock that could warrant the enormously difficult and complicated research planning task to which I am inviting attention.

GARDNER MURPHY
The Menninger Foundation

Human Genetics in the World Population Conference

Two sessions of the Rome Population Conference in September of this year were devoted to human genetics. The first was on the subject, "Relation of Population Changes to the Distribution of Genetic Factors," with Jan A. Böök and Curt Stern as joint chairmen. The second on the subject, "Methods of Research on Relations Between Intelligence and Fertility," with J. A. Fraser-Roberts as chairman. Twenty papers were prepared for these two sessions. The first meeting was divided into three sections, and the papers for each were ably summarized by Böök, Penrose, and Stern. In preparation for the second meeting, a conference had been held in Paris under the auspices of UNESCO, and

the papers presented in Rome reflected this preliminary work. Between two and three hundred people were present at the two meetings, and there were in all some forty people taking part in the discussions.

The Scandinavian countries were represented by Tage Kemp, Director of the Danish government's University Institute for Human Genetics; Karl Evang, Director General of Health Services in Norway; Jan A. Böök, Assistant Director of the Swedish State Institute for Human Genetics; and Torsten Sjögren of the Psychiatric Clinic of the Karolinski Institute of Sweden. Germany was represented by Hans Nachtsheim, Director of the Max-Planck-Institute in Berlin; Italy by Luigi Gedda, head of the G. Mendel Institute of Medical Genetics and Twin Studies; Japan by Yoshio Koya, Director of the Institute of Public Health in Tokyo. These names deserve particular mention because they indicate the important place given to the study of genetic factors by the governments and universities of these countries. There were present able geneticists from England, France, the United States, South America, and many other countries, but their governments and universities give far less recognition to the subject of human genetics.

The Rome Conference developed a valuable summary of presently accepted scientific knowledge. It will shortly be available in the reports and proceedings of the conference and should be required reading for everyone interested in man's future. The ground it covers may be briefly reviewed.

In the western European countries the increase of the life span from thirty or forty to around seventy years, together with the success of the antibiotics and immunization, has led to a great rise in the proportion of people suffering from hereditary defects and deficiencies. Large numbers of people who formerly died from environmental causes now survive and with advancing years develop the hereditary afflictions which because of their late age of onset have undergone little contra-selection. It was agreed that the proportion of persons incapacitated by genetically based, severe, physical and mental deficiencies in European and North American populations amounts to no less than 2 to 3 per cent at any given time, and several authorities held that the total morbid risk for severe genetic disorder is of the magnitude of 5 to 10 per cent. New techniques of diagnosing carriers will add materially to the efficiency with which genetic disorders can be handled. It has become increasingly apparent that each individual is heterozygous for a number of recessive genes with undesirable homozygous effect. The positive identification of carriers will represent a great advance.

In the western European countries the break-up of isolates is having important genetic consequences. (The term "isolate" is given to groups whose marriage circle is small, as indicated usually by the proportion of consanguineous marriages.) If we can judge by the example of France, the change to larger marriage groups has taken place with extraordinary rapidity since the mid-nineteen-thirties. This must result in at least a temporary decrease in many rarer genetic deficiencies, but this decrease will not take place with traits which depend on recessives with relatively high frequency or on dominant genes, nor will it result in any actual diminution in the number of pathologic genes scattered throughout the population. Indeed over the generations the proportion will increase until it again reaches an equilibrium between mutations and the loss of homozygotes. At the same time the break-up of isolates means a loss of adaptive gene combinations. This loss is considered difficult to evaluate. Research is needed on the physiological effects of race crossing. While the old isolates are breaking up, new isolates are being formed by the process of assortative mating in a mobile society.

Differential fertility appears to be decreasing in western European countries owing to the wider use of family limitation practices. Fears of immediate decline in intelligence owing to differential fertility, or indeed of any decline at all, may be groundless, but there is some balance of probability in favor of the view that a genetic loss may be taking place—this being masked by improvements in social and educational conditions and other factors.

Recent discoveries with respect to the processes of selection for or against heterozygotes, as well as the previously known processes of selection for or against homozygotes, should warn of the pitfalls facing hasty generalizations with regard to the genetic results of present demographic trends.

In European and North American countries genetic disorders should be a major concern of public health authorities and medical research workers. In underdeveloped countries the measures, in order of significance should be these: (1) Reduction of excess fertility, (2) control of infectious diseases and nutritional deficiencies, (3) control of genetic disorders.

In regard to nearly every aspect of human genetics solutions of the nature-nurture problems are of prime importance in reaching conclusions on the distribution of genes in the population. Twin studies are a most valuable method for the evaluation of the hereditary and environmental components of an unlimited range of traits.

The following quotations are taken from the concluding remarks of the chairmen of these meetings, themselves eminent geneticists:

> "Were it not for man's genetic diversity which, among other things, basically influences individual mental aptitudes, progress would probably not occur. This broad statement would, I believe, be accepted by all authorities in the fields of biology and genetics. Man's diversity in regard to his genetic potentialities has such far-reaching consequences that it should not and cannot be left to the consideration of only biologists and geneticists."
>
> "Present frequencies and distributions of human genes are the result partly of processes beyond the control of man, and partly of man's voluntary actions and inactions. In an increasing manner, future frequencies and distributions will be predictable on the basis of human activities. This will mean increased responsibility, since whatever we do or omit doing has its definite, unescapable consequences."

PREVALENCE OF GENETICALLY BASED PHYSICAL AND MENTAL DEFICIENCIES AND THE FREQUENCY OF RELATED GENES:

*Information on Population Groups and Methods of Investigation**

TAGE KEMP
Professor of Human Genetics
University of Copenhagen

BY HEREDITARY DISEASES and genetically based deficiencies we understand those which essentially depend on pathogenetic genes. In addition many defects and lesions occur only when a hereditary predisposition is present, but depend, to a smaller or larger extent, on environmental factors.

There is a gradual transition from minor anomalies to proper abnormalities and diseases affected by heredity, which interfere with the free development of the individual by reduced capacity to work or invalidism and a diminished chance of unchecked reproduction. Some genetically based deficiencies manifest themselves from birth; others do not give rise to symptoms till later in life. Some are stationary or progressive; some show remission or may even, apparently at least, be completely cured. Many hereditary lesions do not respond to treatment; they can be checked only by means of genetic-hygienic measures; other genetically based diseases are accessible to treatment which, however, only in some cases leads to complete restoration of health. The favorable results of treatment may, however, involve a rise in the prevalence of these diseases. Hence effective prevention is also important where these are concerned.

The hereditary diseases are constantly arising through mutation; some of them—anomalies and less severe diseases—persist through many generations, while others, the more serious dominant defects and diseases, disappear very fast, after one or a few generations. It is supposed that a certain equilibrium exists between the mutation rate and the elimination of the pathological gene, on the whole keeping the frequency of a hereditary disease unaltered in the population.

In this respect, however, a number of different factors are interacting. Any disease or any defect is the cooperative result of hereditary and environmental influences, and the same abnormality may be caused by one or several different genes or by non-genetic factors.

Some lesions are chiefly due to heredity, each generally caused by a single pathological gene, arisen through mutation in the past, perhaps many generations ago, perhaps more recently. The acquired diseases on the other hand are principally caused by environmental factors. Between these two extremes lie the majority of lesions, for the production of which both genotypical and paratypical factors may assert themselves; they are dependent on a hereditary predisposition.

Hereditary diseases are monomeric in many cases, though not in all, but are often also dependent on modifying genes, and always more or less dependent on the entire gene milieu. The hereditary lesions *sensu strictiori* are generally caused by what have been termed major mutant genes. Several hundred such genes have been identified in man, producing definite defects and abnormalities, of course operating on the variable background of the other genes and

*Presented at World Population Conference, Rome, September 1954.

the environments. The hereditary diseases caused by major mutant genes are as a rule rare.

Predispositions to diseases that in a greater or lesser degree are hereditary must generally be regarded as polymeric. They are graded characters dependent on many genes, which, when appearing alone, have but little effect. In some cases, probably, the so-called polygenes and supergenes are in action. Diseases of this type, as oligophrenia and cancer, may be caused by several reciprocally independent genes or by polymeric genes and by non-genetic influences. Also the possibility of phenocopies and of cytoplasmic or maternal actions and of milk factors may in some cases be considered.

The future development and genetic composition of a human population are dependent on a variety of factors, hereditary as well as environmental, endogenous as well as exogenous. A very important group of these factors which determine the fate and survival of a race or a nation is composed of the hereditary deficiencies, abnormalities and diseases occurring in the population.

This is why the study of hereditary lesions is of so great consequence for population problems, human genetics, medical statistics, public health, clinical, preventive and social medicine, sociology and politics. In democratic countries during recent years, an increasing social consciousness has been manifesting itself, a growing feeling that society must make living conditions tolerable for everybody; this has necessitated the study of the hereditary diseases, and not least of their prevalence in the population. It is of importance to governments and social authorities to know the number of people who, because of hereditary lesions, are socially incapacitated and have to be given social relief, to be treated, or to be placed in hospitals or institutions.

Furthermore, the study of the frequency of defective traits is an essential part of medical genetics. It is fundamental for investigations on the significance of mutation as a cause of disease and on the way hereditary lesions arise through mutation; for investigations on their mutation rate and on the manifestation, penetrance and expressivity of pathological genes; and for studies on the distribution of these genes through the generations in the various social strata and geographical localities. These processes are dependent on the effects of selection, assortative mating, intermarriage, isolates, selective emigration, immigration and deportation, race discrimination, differential fertility, genetic drift and other similar factors.

A human population is a living body, continuously changing in its composition, variable and inconstant, in progressive or retrogressive development, following the rules of natural selection and evolution, or doing away with these rules as a result of culture and civilization. Knowledge of the prevalence of conditions affected by heredity makes it possible to follow and control the development and the fluctuation of hereditary diseases in the population, and to check up on the behavior of these diseases down through the ages.

Many attempts have been made, using various methods, to estimate the prevalence and incidence of hereditary defects and diseases in various countries or groups of populations; some information concerning the prevalence of hereditary diseases was obtained centuries ago through vital and medical statistics, and health services are still collecting material elucidating this question. Direct investigations concerning the problem have been carried out for the most part during the last fifty years, originally on mental defects and diseases, but later within the whole field of medicine.

Several methods have been used to investigate the morbidity in the average population and to ascertain the amount of hereditary tainting, as, for instance, census investigations, sampling methods, morbidity and hospitalization statistics, and medi-

co-genetic registration. These methods may be used in various ways.

Sampling methods are often applied combined with proband materials or propositi investigations; and it must be considered whether the sample is representative of the average population and fulfills certain assumptions with regard to selection and composition. Census investigations may include greater or smaller geographical units, states, counties, municipalities, communities, islands, valleys and so on, or population groups delimited according to sex, profession, social class, race, nationality, etc. Various age groups may be examined, for instance, new-born, schoolchildren, military conscripts or certain age classes; or mortality statistics may be used.

The "prevalence" of a disease refers to the number of cases at a given time in the population, the "incidence" of a disease to the number of cases developing over a certain period of time. Thus prevalence = incidence × length of illness. The incidence at birth can be estimated directly only for such hereditary diseases as are easily recognizable in new-born infants, e.g., grave physical defects. This is done simply by counting the number of infants born with the defect or the disease concerned within a certain group. Conclusions cannot be drawn, however, concerning the incidence of a disease in the population from the results thus obtained, because the mortality generally is higher in affected than in normal individuals. Harelip and cleft palate, for instance, occur in 0.15 per cent of all new-born infants, whereas the incidence in the total population is only about 0.1 per cent. Within the first year of life alone the mortality for infants with harelip and cleft palate is 25 per cent. Other lesions, e.g., congenital dislocation of the hip, are not always recognized at birth. The prevalence is therefore apparently higher in the total population than at birth.

For the very few hereditary diseases where all or nearly all cases are hospitalized or submitted to special public care direct estimation of the morbidity is, of course, possible without examination of the total population. But if all cases are known of blindness or deaf-mutism, for instance, the difficulty consists in distinguishing between inherited and acquired cases.

A very elaborate method for calculating the incidence of hereditary diseases is that of procuring the date, by the aid of birth records, of all persons born, say 60 years ago, within a certain territory to get information on hereditary diseases both in those still alive and also in those who have died, and their ages at death.

Consideration must be given to the fact that a group of hereditary diseases come on only within a certain age period, the *period of manifestation* or the risk zone (*Gefährdungszeit*). This does not, of course, apply to congenital defects such as hereditary deformities or oligophrenia. But many hereditary diseases, which to all appearance are not congenital, come on within a limited period later in life. Thus, the risk zone for schizophrenia is generally set between 21 and 40 (or 16 to 50) years and for manic-depressive psychosis between 21 and 50 (or later). The great majority of the cases of Graves' disease occur between the ages of 20 and 55. Genuine epilepsy usually first manifests itself between 5 and 20 years. Regarding mental deficiency, all individuals who have completed their 10th year of life without displaying signs of this abnormality are regarded as normal in statistical calculations of this kind.

By determining the number of individuals within a group presenting a hereditary disease with a limited period of manifestation, we get information on the prevalence of the disease in the population. As a rule it is, however, a matter of greater interest to find the probability of each individual getting the disease if he lives through the whole risk zone, i.e., to find the *morbid risk* (or the morbidity risk or the expectancy, *Krankheitserwartung*) for the disease concerned in the population. But in calculat-

ing the morbid risk, consideration must be taken both of the age at onset of the disease and the age distribution in the group examined. In the individuals who have not yet reached the risk zone, all have a full chance of getting the disease later in life. Those who are in the midst of the manifestation period have a certain, though smaller, chance of getting the disease, decreasing with increasing age; and only for those who are old enough to have passed the entire risk zone is the morbid risk nil. The morbid risk may be calculated as the cumulative incidence of the disease for all age groups until the end of the period of manifestation.

During recent years new possibilities have been created for investigations on the frequency of hereditary diseases in the population in countries or regions where a medico-genetic or genetic-hygienic registration has been established. A Medico-Genetic Registry includes a systematic registration or card-index covering all the patients in the country who are afflicted with a serious hereditary affection, and also their families. Such registers have been made in small districts in various countries. In Denmark, however, a genetic-hygienic register exists covering the whole country. It is kept in the University Institute for Human Genetics in Copenhagen.

At present about 200,000 patients and their families are registered in the registry, and every year several thousands are added. The registry forms the starting point for more thorough studies into the inheritance of the various lesions and diseases. The procedure then is as follows: The physician, who is trained as a specialist in the field concerned, makes a thorough investigation of the individual patient having the disease or lesion in question, and for the more rare diseases it is attempted as far as possible to compute all cases of the disease in the country; for more common lesions it is generally not possible to accomplish a complete census and then a representative sample is collected. In this way more or less thorough information concerning the frequency of several hereditary lesions in the Danish population is obtained, and some of the results will be mentioned in the following sections.

Knowledge of the prevalence of a hereditary disease does not permit direct conclusions to be drawn concerning the frequency of the corresponding genes. But this can be calculated from the morbidity or the morbid risk if the mode of transmission of the disease is monogenic, and it is inherited according to Mendel's laws, if we know the penetrance of the gene, and on the assumption of random mating.

If we call a dominant gene D and the recessive allelomorph R, and if the gametes containing D and R, respectively, occur at the frequencies d and r $(d + r = 1)$, we know the following.

Frequency of RR in per cent $= r^2 \times 100$, $r = \sqrt{RR} : 10$

Frequency of DR in per cent $= 2\,dr \times 100 = 20\sqrt{RR} - 2\,RR$

Frequency of DD in per cent $= d^2 \times 100 = 100 - 20\sqrt{RR} + RR$

The frequencies of the genes d and r can be calculated from these formulae, if we know the percentage frequency of RR or DD. Table 1 can be calculated by means of this formul

If those having the recessive character are very few, then the heterozygotes will be proportionally very common. If the frequency of a recessive disease, for instance, is 0.1 per cent, then, as Table 1 shows, 6.12 per cent of the population must be heterozygotes; and if the frequency is 1 per cent, 18 per cent are heterozygotes.

It appears further from Table 1 that dominant diseases nearly always occur in the heterozygous form. If the frequency of a dominant disease is 1 per cent, which is relatively high, it is present in the homozygous form in only 1 out of about 40,000 cases. In cases of rarer dominant diseases the homozygous form is still more exceptional. These calculations apply, however,

TABLE 1

	Recessive Homozygotes	Heterozygotes	Dominant Homozygotes	Individuals with Dominant Character
Zygotes:	*RR*	*DR*	*DD*	*RD* + *DD*
Frequency:	r^2	2 *dr*	d^2	$1 - r^2$
	%	%	%	%
	0.01	1.98	98.01	99.99
	0.1	6.12	93.78	99.9
	1	18	81	99
	10	43.2	46.8	90
	25	50	25	75
	99	1	0.000025	1

only on the assumption of random mating, which hardly ever occurs in human populations.

More than 500 hereditary defects and diseases are today known in man, and not less than 2 to 3 per cent of the population suffer from severe hereditary affections. An enormous number of publications have appeared concerning the prevalence of these deficiencies in the various countries all over the world. Summaries of reviews are given in the publications indicated in the literature list.

Some of the results concerning the prevalence of various genetically based deficiencies are mentioned below. It has to be emphasized, however, that the possibilities for comparing the various calculations and investigations are limited, owing to differences in the methods employed and the varying qualifications of the investigators; to this may be added the uncertainty of diagnosis. Furthermore the individual types of diseases are in many cases difficult to define, and often they do not constitute etiological entities.

The prevalence of *deaf-mutism* (congenital and early deafness) varies with time and place. It ranges from 0.04 to 0.09 per cent, slightly higher in males than in females. In England and Wales (1937) 0.08 per cent was counted, in France (1926) 0.046, in Germany (1925) 0.059 in males and 0.050 in females, in U.S.S.R. (1926) 0.083 in males and 0.074 in females, in Sweden (1930) 0.095 in males and 0.079 in females, in U.S.A. (1930) 0.047 in males and 0.046 in females, and in Denmark (1940) 0.046 per cent in males and 0.040 per cent in females.

Statements concerning the proportion of hereditary cases differ considerably, ranging from 10 to 80 per cent. In Denmark (1940–45) about half the number were cases of hereditary deaf-mutism (0.02–0.03 per cent), most of them sporadic-recessive deaf-mutism, and only a few cases (less than 5 per cent) heredo-labyrinthic deaf-mutism. Retinitis pigmentosa occurred in about 6 per cent of deaf-mutes. The proportional frequency of endogenous deaf-mutism—the percentage of hereditary cases among the total number of deaf-mutes—must be expected to increase considerably in the future. The same holds true as regards other deficiencies, as for instance, blindness and oligophrenia. The exogenous cases are decreasing; the endogenous remain constant or are even increasing as a result of the progress of civilization.

The prevalence of *blindness* varies from one country to another. At present it is about 0.05–0.06 per cent in many countries; in Denmark in recent years more than half the cases are hereditary. It is particularly the exogenous blindness which varies in frequency according to time and place. The prevalence of several hereditary eye diseases has been estimated recently as follows, *congenital aniridia* 0.001 per cent; *iridochoroidal coloboma* 0.024 per cent; *congenital hydrophthalmos* 0.008 per cent; *glaucoma* 0.055 per cent; *retinitis pigmentosa* 0.005–0.02 per cent; *partial color blindness* in males 7 per cent, in females 0.4 per cent (in Eskimos in East Greenland,

1952, 2.5. per cent in males, 0.4 in females, a small sample, in West Greenland 6.8 per cent in males, 0.8 in females, in Indians 1, 1-2,4 per cent and in Chinese 5 per cent); *total color blindness* 0.0003 per cent in total population, but in a small isolate group 1 per cent.

The prevalence of *congenital malformations* varies somewhat from country to country. In the state of Rhode Island the incidence at birth from 1936–52 was for *anencephalus* 0.193 per cent; for *spina bifida* 0.253 per cent; for *hydrocephalus* 0.09 per cent. Other prevalences (partly from recent Danish investigations) are *harelip* 0.07 per cent (incidence at birth 0.11 per cent); *isolated cleft palate* 0.03 per cent (at birth 0.04); *congenital dislocation of the hip* 0.15 per cent; *chondrodystrophy* 0.002 per cent (at birth 0.01 per cent); *osteogenesis imperfecta* at birth 0.002 per cent; *hypospadia* in males 0.3 per cent.

As regards the prevalence of *mental deficiency* great variations of from 0.8 to 3 or 4 per cent appear in the results of the various investigators according to definition and methods. In Denmark (1940) the prevalence of feeble-mindedness (including idiocy, imbecility and debility (morons)) was 1.3 per cent (1.0 per cent for hereditary cases, 0.3 for non-hereditary). Idiots comprised 0.1 per cent, 0.2–0.3 per cent imbeciles; 1.7 per cent were mentally retarded. Prevalence of Mongoloid idiocy was 0.025 per cent (at birth 0.15 per cent).

For other frequencies of diseases affected by heredity (chiefly according to recent investigations in European countries) the following may be cited: *schizophrenia* 0.3 per cent (morbid risk 0.9 per cent); *manic-depressive psychosis* morbid risk in males 1.0, in females 2.2 per cent (in a North-Swedish population the prevalence and the morbid risk of schizophrenia were three times as high as indicated above, and manic-depressive psychosis was extremely rare). The *total psychosis expectation* up to 55 years is about 3 per cent in men and 5 per cent in women; *mentally abnormal* evt. periodically in the age range of 10–55 years were 12 per cent. The morbid risk for *epilepsy* is about 0.3–0.5 per cent (or higher). The prevalence of *diabetes mellitus* is 0.5–1.0 per cent, and the morbid risk in males 1–5 per cent and in females 2 to 7 per cent; the prevalence of *hemophilia* was 0.002 per cent in males.

In conclusion, the significance of knowledge concerning the frequency of defective traits for all studies and investigations of population problems should be emphasized.

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USE OF INTELLIGENCE TESTS IN POPULATION STUDIES*

PHILIP E. VERNON
Professor of Educational Psychology
Institute of Education
University of London

IN THE PAST 50 years there have been innumerable investigations of the intelligence test scores of population samples such as different national or racial groups, also of subgroups within populations, such as children of different social class, or from families of different size. Though the investigators' aim has usually been to compare the innate intellectual capacity of these groups, they have become increasingly aware that their test results might be affected by cultural or environmental differences. As early as 1923, Gordon showed that valid comparisons of normal English children and of canal-boat or gipsy children on the Binet test were distorted by the latter's lack of schooling. Much controversy was aroused by the Army Alpha and Beta testing of American recruits in 1917-18 when it was pointed out that the differences between the scores of men of different national descent might be due, not to genetic factors, but to the differing socio-economic and educational advantages of these populations. More recently the Iowa investigators, Bernardine Schmidt and other American psychologists, have published evidence of very large effects of early upbringing and of education on the I.Q.: while Eells, Havighurst and Davis have claimed that most group test items give marked advantage to children of superior social class. Though these views, together with the Communist condemnation of intelligence tests, may be exagerated, even the more cautious students of the heredity-environment problem, such as Burks and Burt, admit that environment may account for roughly a quarter of the variance in scores on reliable tests like the Stanford-Binet. Unfortunately, genetic population differences are usually quite small, hence even a minor cultural difference may seriously distort, or obliterate, a genetic one. Consider, for example, the Scottish mental surveys of 11-year-old children in 1932 and 1947. A decline of about 1 point of I.Q., attributable to the greater fertility of the least intelligent families, might have been expected over this period. Actually a rise occurred in mean group test score, and this was plausibly interpreted as due largely to the greater familiarity of most Scottish children with such tests on the second occasion. Representative samples were also tested with Stanford-Binet and/or Terman-Merrill, that is, individual tests which were probably *not* influenced by this increase in test sophistication. Yet even here no decline was found; the two population means were almost identical. Numerous possible explanations have been discussed, but the simplest one is that a 25 per cent impregnation of test results with environmental components might be sufficient to invalidate the predicted decline. The conditions of upbringing and the amount of stimulation of intellectual development that the average child gets in large families might account for the observed difference of about 10 I.Q. points between only and 2-child families on the one hand, and children of families of 8 and over on the other. My colleague, Mr. C. Bibby has calculated the effects on the mean I.Q. of the next generation and has shown that the anticipated drop of about 2 points might be halved, or wiped out altogether, or even that a slight increase might

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occur, depending on the strength of this adverse environmental effect. I do not suppose myself that this is the whole explanation, but I do hold that our present tests cannot provide direct proof of the existence of genetic family differences.

Now this figure of 25 per cent still implies that the major differences between children of high and low I.Q. are innately determined *within any one cultural group*, such as the British or the American whites. But it is almost certainly an underestimate when cultural differences are greater, as between British whites and African Negroes, or even between British adults who have received advanced secondary or tertiary education and those who left school at 14 or 15. I have recently published strong evidence of greater environmental effects on intelligence tests among young adults and have shown how largely their performance depends on the quality and quantity of education and the stimulating or depressing nature of their intellectual environment during adolescence. In other words, genetic influences are predominant only so long as the childhood environment and primary schooling are relatively homogeneous or standardized for all members of the populations being tested. This means that most national or racial comparisons are entirely illegitimate, since there are such wide cultural differences in the childhood intellectual stimulation and the schooling that different countries provide. Anthropologists such as Nadel and psychologists with experience of race differences like Biesheuvel have further pointed out the effects of motivation and attitude to taking tests. Such factors can generally be ignored in testing children in our Western civilization, since they are all brought up at school to give oral or written answers to questions set by adults, and to work quickly at intellectual tasks on their own. But the cultural pattern is often very different in, say, Africa or aboriginal Australia. The attitude to working at speed may be absent, and the accepted method of tackling problems may be group discussion rather than individual effort. Thus their performance on European or American-made tests is likely to be hopelessly unrepresentative.

Far too many psychologists have supposed that by substituting pictorial, non-verbal or performance tests for verbal group or Binet tests, they could eliminate environmental influences. It is surely obvious that children of superior social class gain far more experience with blocks, pictures and the like than those of lower class, and that there are still greater cultural differences in reactions to such materials between primitive and civilized communities. Nadel and Biesheuvel supply many illustrations of this. In my own research with recruits there was no indication that the *g* or general intelligence factor measured by a non-verbal test of the Matrices type was any less dependent on education than that measured by verbal tests, nor any less correlated with family size. When such non-verbal or performance tests do show smaller differences than verbal ones between groups with different upbringing, it is likely that they are either less statistically reliable tests, or else that they measure a mixture of other abilities — spatial, manual, etc. — besides general intelligence.

The views that I have stated so far may sound very disheartening, but actually they imply, not that all population studies of intelligence are invalid, only that very much greater precautions are needed than have usually been taken in the past. Moreover they do not affect the use of tests for predictive or other purposes *within* any one cultural group. Take for example the selection of bright children for advanced secondary education in Britain, or of "intelligent" recruits for specialist jobs in the Armed Forces. It does not matter if their test scores are somewhat dependent on social background and education, since on the whole the better-class and better-educated individuals also do better at secondary school work or in complex occupations than do the less privileged. Thus even

if it were possible to devise tests which really measured innate potentiality, they would actually give poorer predictions than those we employ at present.

But our conclusions do mean that the search for "culture-free" tests is illusory. Even if we attempted to discover some intellectual skill new to both cultures that we wished to compare—say the learning of Esperanto or calculus—the relative levels that they reached would still depend as much on the similarity of this skill to their own cultural habits as on their basic intelligence. However some progress might be made in the direction of culturally intermediate tests. According to Shimberg, if mental tests are constructed from words and situations familiar to rural children, such children do better on them than do urban ones, although normally inferior on more conventional, presumably urban-loaded, tests. No one has tried applying to British or Americans a test designed by Australian aboriginees to suit the ways in which aboriginees normally express their intellectual capabilities. But it would probably be wiser to take pairs of groups whose divergences were less extreme, and then to attempt to arrive at a test which would be fair to both. Careful anthropological investigation would be needed first to discover the forms taken by the most complex intellectual functions in each group. We must realize that intelligence itself is a different entity in each group. True, it is limited by some universal innate potentiality (which we have no means of measuring), but the way it realizes or manifests itself depends on the group's values and ethos. Thus although Western civilization values highly symbolic reasoning, and this activity provides scope for our most highly saturated *g* tests, another group's intellect might be most fully extended in a very different field of activity —say religious rituals, hunting or farming. It would be necessary then to devise tests within this field, and by means of factor analysis to arrive at the structure or make-up of the Highest Common Factor or *g* in the group's abilities. But if the cultures were not too dissimilar, tests might be found which had good *g* loadings in both. I would suggest tentatively that one of the most fruitful types of test for spanning a variety of cultural groups might be oral directions. It is a pretty universal activity to give verbal instructions and orders for the carrying out of complex tasks, and such directions can be expressed in very simple language which need be little affected by differences in schooling. Anthropologists might indicate to us a number of other widespread values and activities which would better repay exploration than the popular pictorial, diagrammatic, maze, or formboard tests.

I doubt whether this approach could readily be extended to comparisons of sub-groups within a culture, such as members of different-sized families. Eells's and others' attempts to arrive at tests unaffected by social class do not seem very promising, and they ignore the well-established existence of genetic class differences. Conceivably a social psychologist or anthropologist might construct new intelligence tests which reflected Western lower-class values. This might be easier if he himself was, say, of Oriental origin, so that his own outlook would be less impregnated with our upper-class values. But the alternative, and more fruitful, approach is to control or match cultural differences between sub-groups (much as Chronological Age has normally been matched in all investigations of children's intelligence). Numerous research studies such as Burks's and Leahy's, Van Alstyne's and Hebb's, indicate the factors providing intellectual stimulation in early childhood which need to be held constant—time given by adults to conversation and play with children, vocabulary level and rationality of adults, provision of play materials and books, goodness of schooling, and motivation towards doing tests. By applying a carefully constructed rating scale of these relevant environmental influences,

it should be possible to match, say, families of 2 and 4, or of 5 and 9, children; though we could hardly hope to equate families of 1 and 12 children. Adjacent social-class groups might be similarly compared. In actual practice, analysis of covariance would obviate the need for precise matching. The trouble is, however, that this procedure would probably over-compensate; for only the genetically more intelligent large families might provide as good environmental stimulation as small families. We seem then to be forced back to the technique of researches such as Lawrence's, where orphaned children who were brought up in the same institutional environment did show differences in I.Q. which correlated to a small extent with the social class of their fathers. I would conclude, then, that the most rigorous investigations of fertility problems should be based on orphans or foster children whose true parents' families differed in size.

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DISTRIBUTION OF GENES AFFECTING CHARACTERISTICS OF THE POPULATION

Probable Trends*

TORSTEN SJÖGREN
Caroline Institute
University of Stockholm

IT HAS NOT BEEN possible to clarify the mode of inheritance in many diseases, but considerable progress has been made by concentrating upon determination of the morbidity risks in the general population and in different categories of relations to probands with the same or another disease. In this way it has been possible to determine empirical risk figures, giving a quantitative picture of the heredity for a certain disease or affording a numerical index for the connection between different diseases.

In studying the way in which changes in the gene-mass and its distribution affect the characteristics of the population, different viewpoints may be applied:

1. From a purely biological viewpoint interest is concentrated upon reproduction, *i.e.*, the way in which the gene-mass is changed from one generation to the other.

2. From a general medical and demographic viewpoint interest is focused also upon the structure and distribution of the gene-mass in the population and upon the effect exercised by the genes.

Thus, the generation is the time unit for the gene-mass in reproduction. In considering the effect of the gene-mass, however, a much shorter time unit often has to be used. In other words, changes in the gene-mass and its distribution are measured purely biologically by comparing a certain reproducing generation with the next reproducing generation. The gene-mass in the population, however, may be changed in other ways, e.g., by an increase in the mean expectation of life; and the effect produced by the genes may be changed by medical advances, shifting social conditions, etc. The latter changes may take place relatively quickly, and all these circumstances must of course be taken into consideration when attempting to assess probable trends.

In investigating the mode of inheritance in special diseases and anomalies, isolate research has been of great importance. In delimited groups or communities that are not too large a certain gene may by chance be considerably more frequent than is possible in a larger population. Through the inbreeding occurring in an isolate, there is a more pronounced homozygotization. In morbid states that may be provoked by different genes, there is more chance in isolates of finding clinical entities that at least, on the whole, have the same genetic background.

The successive breaking up of isolates, whether geographical or social, implies a certain drawback from the viewpoint of human genetic research. It is, however, worth pointing out that it affects the composition of the total gene-mass only to a relatively slight extent. The effect will be, first, an increased heterozygotization—thus there will be an increase in frequency for dominant qualities though this gradually becomes successively weaker. In rare malign recessive genes the effect may relatively be very strong. The breaking up of isolates here produces an effect that overshoots the mark. In the long run, however, if other compensating factors do not appear, an increase in the frequency of the disease in question must be expected until a new equilibrium is reached.

With certain genes an effect may be produced similar to that due to the breaking up of isolates simply because the population learns how the genes exercise their

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effect. Thus, those who know that they may be carriers of a malign recessive disposition will tend to avoid marriage with blood relatives or other suspected carriers. An interesting instance of this is that Lundborg's great investigation on myoclonic epilepsy resulted in the disease practically disappearing from the population.

The majority of hereditary malign diseases in their expressed form entail a biologically conditioned reduced fertility as compared with that in the general population, either because there is excess mortality before or during the fertile age or because the disease in itself prevents marriage or makes it more difficult to get a partner. In diseases comparatively common in the population there is often fairly precise compensation provided for this anti-selection by factors tending in the opposite direction, chiefly pressure of mutation or differential fertility, which implies that carriers have a higher reproductive rate than noncarriers. In certain cases compensation may also be provided, at least for a time, by assortative mating.

It has been asserted in some quarters that fertility is negatively correlated with intelligence, at least within a certain range; in other words that individuals with a level of intelligence somewhat below the average are supposed to have higher fertility than those with average or above-average intelligence, and that this causes, on the grounds of heredity, a successive lowering of the average level of intelligence. There is no doubt that for certain special groups or populations it has been possible to prove differences in fertility of the kind here referred to, but the problem is extremely complicated. The reduction in the birth rate that has characterized practically all western countries during this century has taken a different course in various strata of society. On the whole it may be said that the reduction has occurred earlier at the socially, economically, and educationally higher levels. Because of this, however, one should not jump to any hasty conclusions for the future. Furthermore, an undeniable tendency in the opposite direction must not be overlooked when we come to the very low levels of intelligence. Both before and during the fertile age low-grade oligophrenics have a markedly heightened mortality, and on an average their reproduction is considerably lower than that of the rest of the population.

Differential fertility is of importance in another, and in a certain way very essential, respect. The genes which happen to be represented in individuals with numerous descendants will of course have increased frequency. If any delimited population is analyzed and compared with the population from which it derives for a sufficient number of previous generations, many individuals are found in the earlier population who are not represented at all by descendants, whereas other individuals have a large number of descendants. If one considers here a gene difference selected in advance, it is to be expected—if the population is fairly big—that the frequency will not differ too much in the new population from what it was in the old population. Here, however, many tens of thousands of gene differences are concerned, and it is thus obvious, statistically, that there will be very great displacement of a number of them. Even if, in relation to the total number of genes, only a rather small number of gene differences give rise to diseases and anomalies, the effects must not be overlooked that may be caused by displacement of this kind, e.g., in respect to changes of the gene-milieu that are necessary for the expression of a certain major gene.

For a general assessment of trends it is important to note that if the effect of malignant dominant genes manifests itself at a relatively early age, these are exposed to a strong anti-selection. Even if by chance the genes gain wider dissemination in one way or another, the anti-selection will soon

bring the frequency back to what corresponds to the pressure of mutation and the differential fertility. The only possible alternative is that the effect of the gene is successively weakened. Now for a gene with a certain effect to influence the characteristics of the population, it is not merely necessary that the gene shall have a certain frequency, which changes in the course of time, or that the distribution of the genes shall be changed. A further essential is that the gene shall have an effect that finds expression. To take as an example the monohybrid dominant genes for congenital dyslexia: it is almost a truism to point out that changes in the frequency of this gene are without significance in a population of illiterates, whereas such changes will become clearly apparent in a population in which literacy is the rule. But from a broad viewpoint such changes are not inconsequential. It may, for instance, be observed that the successive urbanization of modern times entails consequences of a similar kind. In a non-industrialized community certain forms of high-grade oligophrenia imply only a moderate social handicap. In such a community there are a sufficient number of occupations of such a nature that these oligophrenics are able to make a productive contribution. But the more industrialized the community becomes, the more such tasks are eliminated, and it is often a great problem to find a suitable occupation for these persons. It may be said, therefore, that these forms of oligophrenia—without any genetic change or any change in the clinical picture having taken place—have acquired an increased malignity. This trend may be expected to be accentuated further in proportion as manual labor is replaced by expensive and complicated machinery. Similarly, successive urbanization and the growing influx of female wage-earners on the labor market have brought about changes in the need for hospitalization or other medical care for certain categories among the sick. Further, the effect of the genes may be influenced by medical advances without this entailing any change in their frequency and distribution, inasmuch as such advances shorten the duration of hospitalization or, in the most favorable cases, prevent the occurrence of the disease. But medical progress may also have a direct effect upon the composition of the genemass. Perhaps the best instance of this is diabetes mellitus, where the discovery of insulin will necessarily bring about a successive increase in the frequency of the gene or genes responsible for this disease.

There are diseases where the frequency is connected with the mother's age at the child's birth. This applies to mongolism. Whether this disease is genetically conditioned or not, it is to be expected that the reduction in the number of children per family will cause a reduction in its frequency.

For the very important diseases in the group of major psychoses, as also for the great majority of cases of low-grade oligophrenia, it has been clearly shown that hereditary factors play a considerable rôle. The mode of inheritance, on the other hand, has not been elucidated, which is largely due to the fact that we are dealing here partly with heterogeneous groups which at the present stage of scientific development cannot be clinically differentiated from one another. The morbidity risks both for the major psychoses and for low-grade oligophrenia are, however, so high that the random effects for the frequency of the conditioning genes cannot be very great. On the whole the breaking up of isolates cannot have any marked quantitative effect as regards the frequency of the major psychoses in the population.

Quantitative effects which cannot directly be said to be genetically conditioned must, however, gradually emerge as regards these diseases, especially on account of the successive increase in the mean expectation of life. We may, for instance, definitely expect that the frequency of senile psychoses

TABLE 1

Main diagnosis	Aggregate morbidity-risk up to 80 years of age in the general population, %		Remaining mean expectation of life compared with that for total population of Sweden, %	
	Men	Women	Men	Women
Psychoses: All forms	4.7	5.7	71	67
Schizophrenia	1.6	1.6	72	63
Manic-depressive	0.9	1.2	95	91
Senile	0.6	0.8	50	60
Presenile	0.7	1.0	60	67
Low-grade Oligophrenia	1.0	0.75	70	70

will increase in the population in proportion as there is an upward displacement of the preponderant age groups. But it is not likely that this increase will give rise to any effect worth mentioning for the reproduction of the genes conditioning this disease. For the affected persons have already passed the fertile age, and it seems extremely improbable that the outbreak of the disease should cause a tendency to reduced fertility in offspring and other relatives who are still able to reproduce.

Morbidity risks for the major psychoses and low-grade oligophrenia in the general population are shown in Table 1, which also gives figures for excess mortality. These figures are based upon the results of a population study and family investigation of a West Swedish rural population which may be regarded as rather typical for the Swedish country districts. The investigation covers a long period of time (1900–1944) for a population of about 25,000 inhabitants. A part of the investigation, dealing with—inter alia—methods, material, and mortality and morbidity risks in the general population, is already complete; in a later part, which will be published soon, the authors (Torsten Sjögren and Tage Larson) discuss the results of the family investigation of morbidity risks for parent and sibs of psychotics and oligophrenics and give a clinical and genetic analysis of the material.

The investigation shows an increased frequency of consanguineous marriages among parents of low-grade oligophrenics as compared with the corresponding frequency in the general population of the area. No such increase, on the other hand, was observed among the parents of psychotics. There should thus be reason to expect that the successive increase of migration and the thereby conditioned reduction in the frequency of consanguineous marriages will bring about a trend of lower frequency of low-grade oligophrenia for a number of future generations.

As may be seen in Table 1, there is a very considerable excess mortality for both schizophrenia and low-grade oligophrenia. The same applies to senile and presenile psychoses, but this has, as has already been mentioned, scarcely any real genetic effect. For manic-depressive psychosis, on the other hand, the excess mortality is relatively inconsiderable. As regards schizophrenia and oligophrenia, the early onset and the excess mortality in themselves imply a strong anti-selection. This is accentuated by the high degree of social and medical incapacity caused by these diseases.

From many viewpoints schizophrenia may be designated as one of the severest of all diseases. Of the total number of beds in somatic and mental hospitals and asylums in Sweden (around 110,000 for a population of 7.1 millions), about 23.000, or 22 per cent, were occupied by schizophrenics in the year of 1951. The trend to be expected here is thus of great importance. A very interesting development has taken place in Sweden in regard to the number of first admissions 1931–1935, 1936–40, and 1941–45, the numbers were 1,666, 1,771, and 1,280 as against a total number of first admitted psychotics, 4,576, 5,455, and 5,392, respectively. This cannot be due to any change in diagnostic prin-

ciple. On the strength of these figures one would be inclined to draw the conclusion that the trend for schizophrenia is successive reduction in the frequency of new cases. As the genetic background for this disease has not been clarified, however, it would be presumptuous to draw any definitive conclusions from this series of figures for the present.

GENETICISTS AND POPULATION STUDIES

"Several years ago I attended a Milbank Symposium concerned primarily with family studies as a method of public health research (1951 Annual Conference, Milbank Memorial Fund). I went there expecting to meet a good many of my fellow geneticists here today and was somewhat taken aback to discover I was the lone representative of our discipline. It was quite educational for a geneticist to see how many ways it was possible to study families in a non-genetic fashion, and also the magnitude of some of the studies in progress. I think it important that we realize that the epidemiologists and the physicians interested in health insurance plans who have been the prime movers behind many of these projects have a lot of very real problems they are trying to get at. Furthermore, the individuals comprising the populations under investigation in these family studies will not accept an unlimited intrusion into their private lives. Under the circumstances, I got the impression of considerable resistance to anyone—regardless of his interests—who wanted to step into some going study and graft one or two more questions on the questionnaire. I wonder whether we as geneticists—granting that the epidemiologist has quite a head start in the study of populations—aren't about ready to organize our own population studies. Such studies will be expensive, but are the only way to get a clear picture of the mortality and morbidity due to inherited disease." (James V. Neel, M.D., Conference on Problems and Methods in Human Genetics, Proceedings, *American Journal of Human Genetics*, Vol. 6, No. 1, March 1954, p. 120)

LEVELING OF DIFFERENTIAL FERTILITY TRENDS IN THE NETHERLANDS*

T. VAN DEN BRINK
Netherlands Central Bureau of Statistics

1. In making a study of differential fertility trends and of the changes taking place therein in the course of time, it should be borne in mind that these trends are influenced by factors of a different nature.

Generally two groups of such factors can be distinguished. First, circumstances of a preponderately objective nature, e.g., factors which, for separate groups of the population lead to differences in the frequency of marriages, in the age at marriage, in the duration of marriages (during the prolific period of the woman), etc. Second, effects of factors of a subjective nature which can be summarized briefly as being the results of birth control. The effect of these factors depends on the attitude of the different groups of the population toward birth control and on the extent to which, actually, the number of children will be restricted by the individuals, *i.e.*, the married couples belonging to each of these groups.

It may be assumed that the former group of factors has always made its influences felt, while the significance of the latter category for trends and changes in differential fertility is only of recent date. For the Netherlands, at any rate, there is no noticeable effect of birth control on the trend of fertility until after the middle of the 1870's, although there are some indications that this factor had already led to some differential fertility.

It is impossible here to go into details about the extent to which each of the above mentioned factors has contributed to the change in fertility. It may be stated briefly that the possibility of such a further analysis depends, *inter alia*, on the nature of available statistical data. Apparent differences in the crude birth rates will be caused by the objective as well as the subjective factors mentioned above, while the isolated effect of the subjective factors will have to be estimated on the basis of marital fertility rates, *inter alia*, specified by age of mother and by duration of marriage.

2. Comparison of the trends of fertility of different population groups for the Netherlands can be made on the basis of the results of the Population Censuses of 1930 and 1947. These censuses produced figures[1] on the fertility of women married before their 25th birthday and who had been married for more than 20 years on Census day. In this way the minimum duration of marriage was maintained as 20 years, and therefore the comparison to be made on the basis of these figures is reduced to marriages contracted before 1927.

Part A of Chart 1 shows a comparison between *urban and rural population* based on the above mentioned fertility rates in municipalities having more than 100,000 and fewer than 5,000 inhabitants, respectively. Fertility of marriages occurring be-

*Presented at the World Population Conference, Rome, September 1954.

[1]Published in "Population Census 1947," Series A Vol. 4. *Existing marriages and marital fertility*. Central Bureau of Statistics, 1951.

fore 1891 (685 and 734 live births per 100 marriages, respectively) shows no big difference. For marriages concluded in the years 1922–1926, these figures were 300 and 450, respectively, *i.e.* a fertility of married couples in rural districts which is 50 per cent higher than in urban districts. In the rural districts the decline in fertility amounted to about 39 per cent, in the urban districts to 56 per cent and in Amsterdam, the capital and largest town in the Netherlands, to 60 per cent. Fertility of the marriage cohorts before 1891 was 2 per cent above the country's general average in rural districts and 5 per cent below that average in urban districts. For the marriage cohorts 1922–1926, the deviations from the general average were +17 per cent and —22 per cent, respectively. These figures do not show any leveling. Meanwhile it appears that the latter deviations are practically equal to those for the marriage cohorts 1917–1921. Moreover, a comparison between the percentage decline in the fertility of marriages from consecutive periods shows that the pace at which the decline went on during the last part of the whole period under consideration slowed down a trifle in urban districts and was accelerated slightly in rural districts.

Part B of Chart 1, giving a distinction by *religions*, shows that a marked difference between the various religious groups already existed in the first of the compared periods. Per 100 marriages of Roman Catholic women occurring before 1891, 837 live births were registered. The relative figures of Protestant women and of women not belonging to any religious denomination were 690 and 654, respectively. The corresponding figures for marriages from the period 1922–1926, were 513, 356 and 275, respectively, which means a decline in fertility of 39, 48 and 58 per cent. This means that for the whole period there has been no leveling of fertility among the various religious groups either. However, the figures for the consecutive 5-year periods show that, after a gradually increasing difference between minimum and maximum fertility rates, differences in fertility of the marriage cohorts from 1906–1911 and following remained practically stationary, and viewed in relation to the declining trend of fertility for the whole population, the relative differences have become larger and larger in each following period: for the marriage cohorts 1906–1911 the fertility of Roman Catholic women (maximum) is 60 per cent higher than that of women having "no religion" (minimum), while for the women married in the years 1922–1926, the maximum lies 90 per cent above the minimum.

It may further be observed that the difference between fertility of Roman Catholic and Protestant marriages from periods after 1911 showed a gradual decrease. However, in proportion to the absolute level of fertility the difference between Roman Catholics and Protestants still increased a little (40–44 per cent).

Part C of Chart 1 shows a comparison between marital fertility trends according to the *husband's occupation*. The difference between minimum and maximum fertility at the end of the period under review is less than in the beginning, in the absolute sense as well as relatively in regard to the general average of the considerably declining fertility. It should be noticed, however, that fertility of professionals remained almost stationary in the period in question. As this group constitutes only a small part of the population, it is important to consider the development of the other groups. Then, the maximum difference appears for the marriage cohorts 1906–1911: agricultural workers, 677 live births per 100 marriages; salaried employees, 369 per 100 marriages. The difference in fertility of these occupational groups has shown a considerable decline since that time: for the marriage cohorts 1922–1926 the figures were 475 and 278 live births per 100 marriages, respectively.

TABLE 1

NUMBER OF LIVE BIRTHS IN EACH GROUP PER 100 FIRST MARRIAGES WITH CHILDREN, CONTRACTED IN THE PERIOD 1924-1928 ETC. AND STILL EXISTING ON MAY 31ST, 1947

Population groups	1924–1928	1929–1933	1934–1938	1939–1943	1924–1928 = 100		
					1929–1933	1934–1938	1939–1943
All existing marriages	381	352	296	209	92	78	55
Largest 4 municipalities	295	273	240	182	93	81	62
Other municipalities	407	374	312	217	92	77	53
Roman Catholic	502	455	366	241	91	73	48
Protestant	337	315	272	198	93	81	59
No religion	270	250	223	173	93	83	64
Professionals	318	310	279	206	97	88	65
Salaried employees	311	300	268	196	96	86	63
Agricultural workers	450	405	330	230	90	73	51
Other wage earners	377	345	286	203	92	76	54

However, there is again hardly any evidence of a lessening difference. Fertility in the marriage cohorts 1906–1910 of agricultural workers was 88 per cent higher than that of the cohorts of the salaried employees, while the corresponding figure for the cohorts 1922–1926 was still 87 per cent.

On the other hand, a leveling can be observed between the marital fertility of salaried employees and wage earners in the period under review. It appears that the maximum difference between these two groups for the marriages taking place in 1896–1900 is: salaried employees 394 and wage earners 685 live births per 100 marriages, *i.e.*, wage earners 74 per cent higher than salaried employees. This margin diminished gradually, and for the marriages concluded in 1922–1926 the ratios were 278 and 378, respectively, *i.e.* wage earners only 40 per cent higher than salaried employees.

3. For a comparison between the more recent fertility trends of the various groups of the population, use can be made of the data on all existing marriages at the 1947 Census.

A summary of the most important returns is given in Table 1. The marriages occurring in 1924–1928, which could be considered as completed in 1947, have been used as a starting point. In the Census publication concerned, the fertility of each population group is measured by the number of live births per 100 first marriages with children, contracted in each period. These figures have not been standardized for differences in the age at marriage and in duration of marriage. These differences, however, are more important for the mutual deviations of the levels of fertility of the various population groups than for the trends of fertility of these groups.

In considering the fertility rates of the *urban and rural* population[2], it appears that the fertility of the marriage cohorts 1929–1933 is lower than that of the cohorts 1924–1928. This is quite natural, because these marriages are not yet completed. However, the fertility thus far (up to 1947) achieved by the marriage cohorts 1929–1933, 1934–1938 and 1939–1943 among the rural population in proportion to the fertility of the cohorts 1924–1928 (92, 77 and 53 per cent of it, respectively) lags behind the corresponding ratios for the fertility of the urban marriage cohorts (93, 81 and 62 per cent, respectively, of the fertility of the 1924–1928 cohorts). This still does not mean that similar ratios will exist for the ultimate total fertility of

[2]Indicated here by the fertility in the largest four municipalities and in the other municipalities. The actual differences between urban and rural population will be larger than is reflected in the figures given.

these rural and urban marriage cohorts, as it is not impossible that procreation in the rural marriage cohorts will continue at such a pace that the arrears, appearing from the above-mentioned ratios, may be made up. Such a development would bring a decline of the fertility of rural marriage cohorts after 1928 at the same rate as that of urban cohorts. In that case there would already be a change in the trend of rural fertility: from figures other than those included in Table 1, it appears that before 1928 the decline in fertility among rural marriage cohorts was slower than that among urban marriage cohorts. Should the arrears of rural cohorts in 1947 shown by the figures mentioned *not* be fully made up, then this would mean that the decline in fertility among the rural marriage cohorts of the past 20 years had been more rapid than that among the urban cohorts. In this case a tendency toward gradual leveling of the fertility of rural and urban population would be going on.

The same applies to the fertility of the various *religious* groups. The number of live births until 1947 from the Roman Catholic marriage cohorts 1939–1943 only amounts to 48 per cent of the fertility of the completed Roman Catholic marriage cohorts 1924–1928. For the Protestant and "no religion" cohorts 1939–1943, these percentages are 59 and 64, respectively.

Here also it appears (from unpublished figures) that even though the existing arrears of the Roman Catholic cohorts should be fully made up, there would be a change in the trend, and in such a way that among the group with the highest fertility (Roman Catholic marriages) in the past 20 years a more rapid decline would have taken place than has been registered before. If the arrears have not been fully made up or if there were some slowing-down in the continuing decline in the considerably lower fertility of the Protestant and "no religion" marriage cohorts, the differences in fertility between the various religious groups still existing today will gradually become smaller.

The last part of Table 1 contains figures on the fertility of four *occupational groups* (social classes). They show a picture similar to that of the urban and rural groups and the religious groups. For all occupational groups the fertility of the marriage cohorts after 1928 is less than that of the cohorts 1924–1928. However, here again this is particularly true for the category whose fertility has always been the highest, the agricultural workers.

The fertility of the agricultural marriage cohorts 1939–1943 is thus far (up to 1947) only 50 per cent of the fertility of the agricultural cohorts 1924–1928. For the marriage cohorts 1939-1943 of professionals and salaried employees, the corresponding percentages are 65 and 63. Here, too, the figures indicate that the deviation between the fertility of these occupational groups is likely to become smaller.

The same development appears for professionals and salaried employees on the one hand and wage earners (without agricultural workers) on the other. Therefore, for these occupational groups there is evidence of further progress toward leveling, which has already been found for these groups in considering marriage cohorts from the periods before 1924–1928.

4. It is not possible in this short paper to enter into further details, e.g., the difference between the fertility trends of various groups of different social level among the Protestants or on different fertility trends of the religious groups among the rural and urban population, or on the influence of the education-level (deviating fertility trends of university graduates), etc.

Such further considerations, however, also support the conclusion already drawn, that on the basis of the data which became available for the years up to 1947, there is a tendency toward a gradual leveling

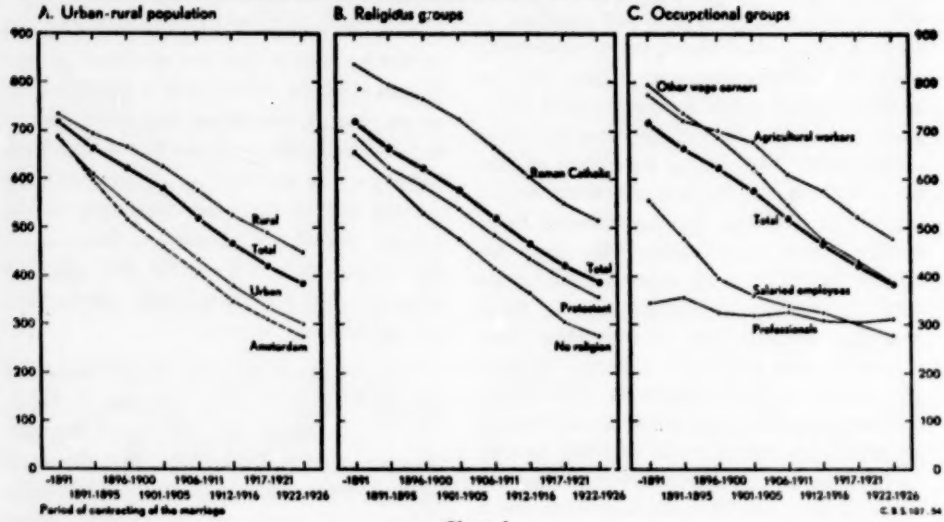

Chart 1

of the differences in fertility of the various population groups. At this moment it cannot yet be ascertained whether this tendency has changed, because fertility after 1947 still remains on a higher level than before the war.

GENETIC DIVERSITY IN THE PEOPLE OF WESTERN INDIA*

L. D. SANGHVI
Human Variation Unit
Indian Cancer Research Centre
Bombay

INVESTIGATIONS CONCERNING distribution of genetical traits in man were few and far between in India, before we started our studies on human blood groups in Bombay in the year 1944. Most of the larger of series of data on ABO blood groups of Hindus from different regions of India are summarized in Table 1.

TABLE 1
ABO BLOOD-GROUP FREQUENCY IN HINDUS FROM DIFFERENT REGIONS IN INDIA

Region	No. of Persons	% of blood group O	A	B	AB	Investigators
North India	1000	31.3	19.0	41.2	8.5	Hirzfeld & Hirzfeld (1919)
Uttar Pradesh	2357	30.2	24.5	37.2	8.1	Malone & Lahri (1929)
Bengal	1302	36.2	21.8	34.6	7.5	Greval & Chandra (1940)
	1372	35.1	20.7	35.9	8.3	MacFarlane (1938)
Madras	1834	39.2	24.4	30.2	4.8	Sheshadrinathen & Timothy (1942)
	830	41.8	22.9	31.2	4.1	Reddy (1943)
	418	42.8	23.9	29.5	3.8	
Bombay	946	39.4	23.8	29.7	7.1	Sanghvi (1944) [1]
	974	35.1	26.3	29.6	9.0	
	1074	37.1	27.2	27.3	8.4	
	491	42.0	22.0	26.7	9.3	

[1] Based on blood bank data from: Red Cross Society, King Edward Memorial Hospital, Wadia Maternity Hospital, and Tata Memorial Hospital.

The data on Hindus in Bombay were collected from four different blood banks. There was no significant difference in the distribution of ABO blood groups from these four different sources in Bombay ($\chi^2 = 14.54$, $P = 0.11$). This however, did not necessarily mean that there was no internal heterogeneity in Hindus residing in the same region. The data from different regions of the country showed highly significant differences (heterogeneity $\chi^2 = 127.8$ for Hindus from North India, Uttar Pradesh, Bengal, Bombay and Madras, $P < 0.0001$) showing an interesting gradient of gene B from North to South. The situation so far was similar to the one found in other countries, where distribution in the same region does not show significant difference, whereas different regions show gradients.

Our next step was to study the distribution of ABO blood groups in two Marathi-speaking castes of the Hindu Community residing in the Bombay State. This was of special interest as Hindus all over the country are divided into a large number of well-defined castes and sub-castes whose members are forbidden by social custom to marry outside their own group. This social custom has a very great authority even to this day. Such "in-marrying" groups have been properly termed as endogamous groups or Mendelian populations.

Marathas and Mahars were the two Marathi-speaking groups selected for this purpose. Marathas are largely cultivators constituting about 40 per cent of the Marathi-speaking people. Mahars form a large section of the untouchables who constitute about 10 per cent of the Marathi-speaking people. The distribution of ABO blood groups in these two castes is given in

*Presented at the World Population Conference, Rome, September 1954.

TABLE 2

ABO BLOOD-GROUP FREQUENCY IN MARATHAS AND MAHARS (MARATHAS CLASSIFIED FURTHER ACCORDING TO PLACE OF BIRTH)

Caste	No. of Persons	Percentage of blood group O	A	B	AB
Marathas					
Ratnagiri	288	30.2	34.7	26.8	8.3
Desh	226	30.1	31.4	27.9	10.6
Colaba	166	34.9	32.5	22.3	10.3
Other regions	178	36.5	27.5	23.6	12.4
Total	858	32.4	31.9	25.5	10.2
Mahars	409	31.8	25.2	34.7	8.3

Table 2. The sample of Marathas is further classified according to the place of birth.

Frequencies of ABO blood groups of Marathas born in different regions of the Bombay State did not show any significant difference ($\chi^2 = 7.41$, $P = 0.59$). The pooled distribution of Marathas and the distribution of Mahars, however, showed a fairly significant difference ($\chi^2 = 13.51$, $P = 0.003$). There was a high frequency of the B group in Mahars compared with Marathas.

So far we had restricted ourselves to the ABO blood groups. A small amount of anti-Rh serum was made available to us at that time. A study of the Rh factor in 100 persons in Bombay showed only 2 Rh-negative persons, 1 out of 14 Parsees and the other among the 11 Indian Christians. All 70 Hindus in that sample, which came mainly from the caste Maratha, were Rh-positive. This observation stimulated us to study the same groups of people with larger samples for the Rh factor as well as other blood groups.

Indian Christians are largely, though not entirely, composed of converts from the poorer classes, who were resentful of their social position in the Hindu Community. Christian missionaries have been active, particularly in southern India, from the beginning of the sixteenth century. The institution of caste has penetrated the religious barrier of Christianity, giving rise to castes like "Braham Christians" and "Sudra Christians." They number 6,040,665.

Parsees are the descendants of the people who fled from Persia after the fall of Zoroastrian Empire in 651 A.D. After wandering about for nearly a hundred years, they were permitted to settle down on the west coast of India. It is not known whether they brought women with them or took them from the neighboring people in India; but after that time they do not seem to have any appreciable matrimonial relations with other groups of people in India. They number 114,890 residing mainly on the west coast near Bombay.

We undertook a study of the distribution of A_1A_2BO, MN and Rh blood groups among the Marathas, Indian Christians and Parsees with samples of 200 persons from each group. The sample of Marathas consisted of schoolboys, the sample of Indian Christians consisted of college students and the sample of Parsees came from hospital patients. The results are given in Table 3.

Frequency of Rh-negative persons among Marathas was significantly lower than in Indian Christians ($\chi^2 = 5.22$, $P = 0.022$) and in Parsees ($\chi^2 = 8.76$, $P = 0.003$), confirming our earlier observation with smaller samples that Marathas have a low frequency of Rh-negatives. There are no significant differences in the distribution of A_1A_2BO and MN blood groups in the three groups.

We also undertook a study of the frequency of consanguineous marriages among

TABLE 3

DISTRIBUTION OF OA_1A_2B, MN AND RH IN 3 GROUPS OF PEOPLE IN BOMBAY

Group of People	No. of Persons	O A_1 A_2 B						M N			Rh	
		O	A_1	A_2	B	A_1B	A_2B	M	N	MN	+	−
Marathas	200	35.5	27.0	4.0	25.5	7.5	0.5	36.5	16.5	47.0	98.5	1.5
Christians	200	39.5	28.5	4.0	22.5	4.5	1.0	33.0	15.0	42.0	94.0	6.0
Parsees	200	41.0	20.0	2.0	28.5	8.0	0.5	37.5	20.5	42.0	92.0	8.0

TABLE 4

FREQUENCY OF CONSANGUINEOUS MARRIAGES

Group of People	No. of Married Couples	First Cousin	First Cousin Once Removed	Second Cousin
Parsees	512	66 (12.9%)	15 (2.9%)	8 (1.6%)
Marathas	137	16 (11.7%)	—	1 (0.7%)

the Parsees and the Marathas. The results are given in Table 4.

There is a very high rate of consanguineous marriages in these groups of people. Further there is an interesting difference in the frequency of the types of first-cousin marriages (not shown in the table). Among the Parsees, the percentages of the four types of cousin marriages are about equal with a little excess of marriages of the children of two sisters. On the other hand, among the Marathas most of the first-cousin marriages involve a boy getting married to his maternal uncle's daughter.

Genetic Diversity in the Endogamous Groups

A systematic investigation was then undertaken to study the distribution of several genetical traits in some of the main endogamous groups of a particular linguistic region. For convenience in field work, we selected the Marathi-speaking area. The map in Chart 1 shows the extent of this region.

The following four groups were studied.

	Number (1931)
Desasth Brahman (D.B.)	302,530
Koknasth Brahman (K.B.)	119,611
Chandrasenia Kayasth Prabhu (C.K.P.)	31,126
Maratha (M.K.)	5,803,780

The caste of Maratha is a single endogamous group, whereas the caste of Brahman is a collection of several such groups. Desasth and Koknasth are two of the twelve divisions of the Marathi-speaking Brahmans. C.K.P. is a single caste. Decennial census figures are available in India from 1881 onwards, but numerical strength of

Chart 1

castes and sub-castes is not reported in all. Latest available figures of these four endogamous groups in the Bombay State from the census reports of 1931 are given above. The group M.K. is spread over the entire Marathi-speaking area. The group C.K.P. is concentrated in western districts near Bombay, the group D.B. is found largely in the southern districts, and the group K.B. in the districts of Konkan and in other urban areas.

These endogamous groups are divided in mutually exclusive sections, whose members are forbidden to marry within their own sections. An exogamous section derives its name from some mythical ancestor to whom all the members of the section own allegiance and are in many castes supposed to have descended in the male line. This rule, incidently, prohibits paternal cousin marriages. There are 15 exogamous sections in K.B., 24 in C.K.P. and more than 80 in M.K. There are variations in the custom of non-paternal cousin marriages among these groups. No such marriage is permitted in K.B. and D.Y.B. On the other hand, not only are such marriages permitted in D.R.B., C.K.P. and M.K. but extravagant emphasis is put on a marriage of a boy to his maternal uncle's daughter. This is the reason for the high frequency of this type of cousin marriages reported earlier in Marathas. (D.R.B. and D.Y.B. are two sub-castes of D.B., which were investigated separately but have been pooled here for convenience of presentation.)

No critical information is available about the origin and evolution of any of these four groups. There is some evidence to suggest that D.B. and M.K. have been residing in this region for a long period of time, Marathas probably dating back to the pre-Christian era. C.K.P. can be traced in this region from the 10th century onwards, whereas there is no reference to K.B. up to the 16th century. M.K. and K.B. were the ruling dynasties successively in the 17th and 18th centuries. Until the rise of K.B. to power, they held a low social position among the Brahmans of Desh and were known as spies. Even after several generations of power and wealth, some of the classes of Brahmans refused to eat with them or to officiate at their ceremonies.

Suitable antisera were available at the laboratory to study ABO, A_1A_2, MN and Rh blood groups. To this battery of tests, two more genetical traits were added: (1) taste reaction to phenyl-thio-carbamide and (2) color blindness of the red-green type. Field work was organized through some society, school or an influential person of the group concerned. The group K.B. and C.K.P. included 100 men and 100 women. One hundred men were examined for each one of the groups D.R.B. and D.Y.B. Two hundred boys of the group M.K. had already been studied for A_1A_2BO, MN and Rh blood groups. Another sample of 200 individuals was therefore tested for taste reactions to p.t.c. and color vision. Only unrelated individuals were taken for study. Table 5 contains a summary of the data relating to the distribution of these genetical traits in the four endogamous groups.

No significant difference was found in the distribution of various genetical traits in D.R.B. and D.Y.B. These groups were, therefore, combined together in group D.B. for further calculations. Women of the group K.B. and C.K.P. had normal color vision and were kept out of further consideration.

There are certain interesting features of Table 5. K.B. has a comparatively high frequency of 0 blood group and C.K.P. has a high frequency of A_2. Distribution of Rh factor has a range from 1.5 per cent negative in M.K. to 10 per cent negative in C.K.P. M.K. and C.K.P. have a remarkably low frequency of tasters of p.t.c. The distributions of American Whites and Negroes for the same genetical traits are given at the bottom of Table 5 for the sake of comparison.

A detailed statistical analysis was car-

TABLE 5

DISTRIBUTION OF GENETICAL TRAITS IN FOUR ENDOGAMOUS GROUPS IN BOMBAY

Endogamous Group	Number of Persons	Genetical Traits: O A_1 A_2 B						M N			Rh		p.t.c.		c.v.	
		O	A_1	A_2	B	A_1B	A_2B	M	N	MN	+	−	+	−	+	−
D.B.	200	37.5	23.0	2.0	30.0	7.0	0.5	34.0	16.0	50.0	95.0	5.0	64.8	35.2	97.0	3.0
K.B.	200	51.0	22.0	2.0	20.0	4.5	0.5	43.5	11.5	45.0	96.5	3.5	65.0	35.0	95.0	5.0
C.K.P.	200	34.5	19.5	9.0	28.5	6.5	2.0	34.0	18.5	47.5	90.0	10.0	53.5	46.5	99.0	1.0
M.K.	200	35.5	27.0	4.0	25.5	7.5	0.5	36.5	16.5	47.0	98.5	1.5	57.5	42.5	98.0	2.0
American Whites*		40.6	30.3	10.1	11.6	5.9	1.6	29.2	21.2	49.6	87.1	12.9	70.4	29.6	91.8	8.2
American Negroes*		45.8	14.5	12.7	19.8	3.5	3.5	26.0	30.0	44.0	91.9	8.1	90.8	9.2	96.1	3.9

*Quoted from Wiener, A. S., Sonn, E. B. & Belkin, R. B. (1945) *J. Immunology* *50*:341–8 and from Snyder, L. H. (1948) *Yale J. Biol. Med.* *19*:817–33.

TABLE 6

VALUES OF χ^2 FOR INTERGROUP DIFFERENCES WITH RESPECT TO GENETICAL CHARACTERS

Group Combination	OAB	A_1A_2	MN	Rh	p.t.c.	c.v.
1. D.B. X K.B.	9.16•	0.00	4.33	0.25	0.00	0.29
2. D.B. X C.K.P.	0.91	9.38•••	0.49	2.92	4.77•	0.46
3. D.B. X M.K.	2.16	0.24	0.38	2.86	1.92	0.10
4. K.B. X C.K.P.	11.93•••	7.65•••	5.73	5.72••	4.95•	1.55
5. K.B. X M.K.	10.05••	0.07	3.10	0.92	2.03	1.77
6. C.K.P. X M.K.	0.60	6.66••	0.41	11.81••••	0.50	0.03

Statistical significance: •indicates $.05 > P > .02$ •••indicates $.01 > P > .001$
••indicates $.02 > P > .01$ ••••indicates $P < .001$

ried out for the six possible pairs of four endogamous groups and each genetical trait separately. Values of χ^2 and their statistical significance are given in Table 6.

There is no significant difference in the distribution of any trait between the groups D.B. and M.K. Both of these groups differ significantly from K.B. in the distribution of ABO blood groups and from C.K.P. in the distribution of A_1A_2 and Rh. D.B. further differs from C.K.P. in the distribution of taste reactions to p.t.c. The greatest differences are found between K.B. and C.K.P. as they differ from each other in ABO, A_1A_2, Rh and p.t.c.

The above evidence substantiates in a broad way the scanty historical information about these groups. It shows similarity between D.B. and M.K. in spite of the fact that socially D.B. and K.B. are supposed to be closer. It also shows a dissimilarity of C.K.P. from the other three groups supporting the hypothesis that it is a migrant group. However, it does not throw much light on the position of K.B.

The pattern of genetic variation among the endogamous groups revealed by this study has shown that the Indian castes are remarkably suitable for a number of investigations in hereditary diseases and defects, some of which are already underway at our laboratory in Bombay.

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FUTURE POPULATION PROSPECTS IN THE UNITED STATES*

WARREN S. THOMPSON

THE CONCLUSION any student will arrive at regarding the population prospects (meaning, I take it, the prospect for change in numbers) in any given area will depend upon his evaluation of the changes likely to take place in the three demographic variables—(1) the birth rate, (2) the death rate and (3) the volume, the direction, and the character of the net migration.

In most western countries, and increasingly in many others, there is a strong belief that, assuming no great unforeseeable catastrophe, the death rate is coming under such a measure of control that it is not difficult to project the number of survivors from any given cohort of the population of today into the future for two or three decades, with reasonable accuracy. This confidence is further strengthened since calculations, based on different, but reasonable, death rates show that the variations in the size of the population derived from the use of these different death rates are comparatively small. Under these circumstances in the writer's opinion any set of age specific death rates which would be considered reasonable by several well-informed students would be satisfactory in trying to assess our population prospects in the United States during the next two or three decades.

With only a few exceptions during the past century and a quarter there has been an excess of persons entering this country over those leaving it. This excess has varied greatly from time to time especially before the quota laws were put into effect. The chief variations have been closely associated with the ups and downs in economic activity although wars have also exercised much influence. Aside from severe economic depression and war the volume of net migration is, in the writer's opinion, likely to remain near the quota level during the next two or three decades. The quota policy now seems to be well established. Besides, calculations on several sets of assumptions regarding the effect of migration on future population prospects can be made so that at any given time that one can be used which accords best with actual or prospective immigration.

The third variable, the birth rate, as we are learning every day, is itself a consequence of so many other variables that at best we can only guess at what it will be a few months hence to say nothing of what it will be over a period of some years. Unlike the death rate which appears to become more stable with increasing control over disease, the birth rate seems to become more variable as the voluntary control over the size of the family becomes more assured. Recent experience in the United States has made us all aware that variations in economic conditions have a strong effect on the birth rate both because they tend to increase marriage when they are good and discourage it when they are hard and because they encourage married people to raise their families sooner after marriage when times are good and to prolong the period during which the children are born when times are hard.

We are also learning, or at least it seems so to the writer, that there may be such a thing as a pattern of thought, a style, so to speak, which can quickly affect the age at which people want to marry, the strength

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of the desire to marry and perhaps even exert a decisive influence on the size of the family desired. The writer believes that this change is itself chiefly a consequence of economic changes. But whatever the cause (s) may be the fact is that we have never had such an increase in marriages and such a reduction in the age at marriage and such an increase in births as has taken place since 1940. But this fact seems to the writer to have led many people to the rather hasty conclusion that the young people of today have abandoned much of the control over the size of their families which their parents exercised, or that they have deliberately decided to raise larger families. Both of these changes may have occurred but several points need careful consideration before they are accepted as facts on which to base a judgment regarding the prospects of future growth. These points can only be summarized here.

In the first place, marrying at a younger age is by no means proof of an effective desire for a larger family. It may just as well reflect the widespread acceptance of the fact that the size of the family can be rather easily controlled and, therefore, there is no good reason not to marry at an earlier age. Today earlier marriage does not necessarily exercise a decisive influence over the size of the family.

In the second place, the reasonable certainty that the size of the family can be controlled may have been the deciding factor in the minds of many young couples in planning to have their children within a shorter time after marriage than has bee customary in the recent past. In addition, the fact that times have been good during and since the war has, without doubt, rendered economic conditions of comparatively small importance in the minds of many young people in spacing their children at intervals of more than two to three years.

In the third place, the increase in the proportion of the women 15–44 years of age who were married, from 62.9 per cent in 1940 to 70.7 per cent in 1950, a proportional increase of over one-eighth, was certain to have a pronounced effect on the birth rate even though there were no changes in the average size of the family, especially since the largest increases in proportions married took place at ages 15–24. At these ages the likelihood of conception is greatest. There is some reason to believe, however, quite aside from economic considerations, that the increasing proportion of persons completing high school and continuing with advanced training in colleges and professional schools will soon place a floor under the age at marriage for an increasing proportion of our population.

It should be noted in this connection that if the age at marriage remains as low as at present and if families are completed to a given size at an earlier age than in the past the length of a generation will decrease and this will lead to a longer period of overlapping between grandparents and their grandchildren and thus add to the population even if the number of births does not increase.

On the other hand, the reduction of the age at marriage has been an important factor in keeping the marriage rate high. As soon as the reduction in the age at marriage ceases, or even becomes slower, the marriage rate will decline because the persons marrying will no longer come, in part, from younger age groups which had not been marrying in the past. The decline in the marriage rate since 1950 may be due, in part, to this factor, although the relatively small cohorts now coming to marriageable age because of the low birth rates during the 1930's is the prime factor. But these small cohorts have already been depleted to some extent by early marriage. The number of new families that will be established during the next few years will, therefore, fall off rather sharply for purely demographic reasons.

It is a sound scientific principle not to

call on unknown factors in explaining a situation until one is certain that the known factors are inadequate to do so. Hence, it seems to the writer that much of the talk about larger families is out of place until the effects of the purely demographic factors in raising the birth rate have been evaluated more exactly.

In addition, it should not be forgotten that these purely demographic changes are themselves the consequences of previous social and economic changes.

It is not difficult, of course, to project the number of births that will occur to the women aged 15–19, 20–24, etc., in 1970 or 1975 if we assume that each 1,000 of them will have the same number of births, or a specified proportion of this number, in 1970 or 1975, as in 1950, since the number of women who will be aged 20 and over in 1975 can be predicted with reasonable accuracy because all of them except those aged 20 and 21 in 1975, are already born and the additions to them by immigration can be assumed without any considerable error. Such calculations are well worth doing on the basis of several different assumptions, but it must be realized that there is very little basis for judging how realistic these assumptions regarding birth rates will prove to be. We do not know what social and economic changes will take place during the next 20 years nor how they will affect the birth rates of the people already born to say nothing of how many will be aged 18–21 in 1975, *i.e.*, those to be born 1954–57, many of whom will be contributing to births at that time.

The cohort method of studying fertility will help to define the pattern of the birth rate and the changes in this pattern more clearly than this could be done in the past. Such studies may also enable us to anticipate with some degree of assurance several years in advance of menopause whether the completed fertility of a particular cohort of women is likely to be greater or less than that of a younger or older cohort. This is all to the good, and by focusing attention on the size of the completed family will enable us to evaluate the effects of social and economic changes upon the actual reproductive behavior of women during marriage (their life time) especially if the size of the family should prove to be fairly constant.

The writer would not for a moment argue that there could not be a rather sudden increase in the size of the average completed family, but he does believe that if such a change is taking place it is the consequence of changes in social and economic conditions. Believing this he also believes that social and economic changes having exactly opposite effects can also take place just as quickly, and under the demographic conditions now prevailing a decline in the marriage rate and an advance in the age at marriage might be even more abrupt than the changes in the opposite direction which took place in the 1940's. On the other hand, the more secure the control over the size of the family becomes the less likely it is that the marriage rate and the age at marriage will fluctuate widely and the more likely it is that the crude and age-specific birth rates will vary considerably within relatively short periods of time. This makes the projection of population growth over comparatively short periods an increasingly hazardous enterprise. The reason for this lies essentially in the relatively long period of married life during which a couple can space the children it chooses to have if it is assumed that comparatively few families will have more than four children and that the age at marriage for a large proportion of women remains in the early twenties.

Under these assumptions but with very considerable uncertainty regarding the continuance of the economic conditions which have encouraged young married people to have their families soon after marriage, the prospects of population growth in the United States which lie

ahead are very uncertain if a specific forecast is desired. There are, however, certain factors in future growth which can be indicated with reasonable certainty.

In the first place, there is a period of several years immediately ahead of us during which the number of first marriages will be relatively small and unless it turns out that a rather large increase in the size of the average family is taking place the smaller number of births to be expected from a decline in the number of new families being established will reduce the number of births considerably during the next few years. Moreover, even a mild economic depression will still further reduce the number of births for a few years. (There appears to have been a marked decline in the number of marriages in November and December, 1953.) After about 1960–62 the increase in births following 1940 should lead to a rapid increase in the number of marriages and the number of births will increase even though age specific birth rates should decline considerably. Thus the period 1965-75 should witness a fairly large increase in births as compared with the period 1955–65 even if there were no change in the size of the family. The most uncertain element, of course, lies in the economic changes which may affect the birth rate very quickly.

The writer is moderately optimistic regarding the probability of a population growth of 10 to 12 per cent per decade during the ensuing two or three decades. He has no difficulty, therefore, in accepting the recent projection of the Bureau of the Census labeled "C" and which yields a total population of approximately 206 millions in 1975, as a fairly reasonable guess. This view assumes, of course, that economic conditions will not arise which render people so uncertain regarding their ability to support a moderate-sized family that they will reduce this size rather abruptly. To say more than this seems to the writer to accept as facts certain assumptions which must remain assumptions until a great deal more is known about the interrelations of social and economic conditions and reproductive behavior.

The writer is not disposed at present to invoke the basic economic difficulties that will arise in caring for a population some 45 to 50 millions larger than at present as a reason for believing the rate of growth will fall much below 1 per cent per year because he believes poverty can be largely eliminated even in this larger population and the level of living of the one-third or one-half now having lower incomes can be substantially raised if we use our resources and technology wisely and effectively. But he is, of course, very uncertain that periods will not be encountered when considerable bodies of men will be unemployed and hence, cannot use their time to produce the goods and services which would insure them and their families a decent living. Under such conditions he is convinced that the birth rate will again fall as it did during the 1930's, perhaps even more rapidly, and that population will grow at a slower rate than 10 to 12 per cent in a decade. It seems doubtful to him, however, that even better economic conditions than the nation has experienced since 1940 are likely to raise the rate of growth to any considerable extent, especially if the improvements in living conditions should be largest in those portions of the population in which they are now the most needed. The most needy portions of the population still have the highest birth rates, and better living conditions for them will probably result in lower birth rates in these groups. The decline in their birth rates will only be partly compensated for by higher rates in the families already in good circumstances, but on the whole it does not seem unreasonable to the writer to look forward to an increase of 40 to 50 millions by 1975 if we do not have another depression and if we keep our people employed.

INTELLIGENCE, FERTILITY AND THE FUTURE

A Report on the 1947 Scottish Mental Survey*

JAMES MAXWELL
Moray House Training College
University of Edinburgh

Procedure

IN 1932 A GROUP verbal intelligence test was administered to 87,498 Scottish eleven-year-old children; and in 1947 the same test was administered to the corresponding group of eleven-year-olds, numbering 70,805. Each group comprised over 90 per cent of the estimated population of eleven-year-olds. In 1932, a sample of 1000 children was given the Stanford-Binet test, and in 1947 a sample of 1215 children, selected by date of birth, was given the Terman-Merrill Binet Test.

The information obtained about the 1947 children was considerably more extensive than that for the 1932 group. For all the 1947 eleven-year-olds, the size of family, the child's position in the family, and various matters of educational interest were recorded. For a 10 per cent sample, the children born on the first three days of each month, the father's occupation, the degree of overcrowding in the home, the mother's age, the child's place of birth, and the child's height and weight were also recorded. It was from this sample that the 1215 individually tested children were drawn; and both the 10 per cent sample and the smaller sample appear to be a good representation of the total eleven-year-old population of the survey.

Comparison of Intelligence Test Scores

On the group test of 76 items, the average score of the 1947 children was 2.3 points higher than that of the 1932 group of children, the standard deviation of test score being about 16 for both groups. After calibration of the two versions of the Binet test, no significant change in average I.Q. was found. The main finding of the two Scottish Surveys thus was, that over a period of fifteen years, there was no sign of a decline in the average measured intelligence of the eleven-year-old child population, and some suggestion of a rise. Explanations of the increase in average group test score in terms of environmental improvement and familiarity with tests are possible but are unproven, and such explanations would require to be established by some positive evidence before being accepted.

Intelligence and Fertility

A definite negative correspondence between the average intelligence test scores of the children and the size of their sibship was established in the 1947 Survey. The correlation coefficients are $r = -0.28$ for the group test, and $r = -0.32$ for the Binet test. The relationship between test score and family size is not known for the 1932 group, but various contemporary investigations did reveal a similar negative correspondence, so it is not unreasonable to assume a corresponding negative relationship among the 1932 children, though its degree is unknown.

It has been suggested that the negative relationship between family size and average intelligence is a function of birth order, the later-born children in a family tending to be less intelligent than the earlier born. The data of the Scottish Survey do not allow of this hypothesis being fully examined, as the children are all from different families, and all families are not necessarily complete. The data as they stand, however, give some indication that

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the last-born children may be slightly more intelligent than the earlier-born children, and there is no sign whatever of a negative relationship between test score and birth order. Because of the method by which the survey children were selected, *i.e.*, all eleven-year-olds, it is impossible to make any more precise statement. On the other hand, the younger sibs of the 1215 individually tested children have also been individually tested on reaching the age of eleven. Here it is possible to compare children of different birth order within the same family. The results (as yet unpublished) show no clear correspondence between birth order and intelligence. It can safely be inferred from the Scottish results that a differential relationship between birth order and intelligence has no part in the negative correlation between intelligence and family size.

On the basis of this negative correlation between intelligence and family size, predictions of a decline in the average level of intelligence have been made; but the decline expected between 1932 and 1947 does not seem to have occurred. This is one of the paradoxes of the Scottish results, and its resolution implies either a "masked" decline, or inadequacies in the methods of predicting future trends from one set of results. The environmental influences said to be masking a real decline have been neither precisely identified nor clearly established as operating; the prediction of future trends is a question that deserves fuller consideration than can be given here.

Intelligence and Social Environment

From the information recorded for the 10 per cent sample in the Scottish survey, it has been possible to make several sociological classifications. The major classification was in terms of the father's occupation. Nine such occupational (or social) classes were distinguished; a brief definition of each is given below, together with the average size of sibship and average group test score of the children in each class.

Occupational Class	*Family Size*	*Test Score*
I Professional and large employers	2.6	51.8
II Small employers and self-employed	3.1	42.7
III Salaried employees	2.5	47.7
IV Non-manual wage earners	3.1	43.6
V Skilled manual wage earners	3.6	37.2
VI Semi-skilled manual wage earners	4.3	33.2
VII Unskilled manual wage earners	4.6	31.1
VIII Farmers	3.9	36.2
IX Agricultural workers	4.3	32.3
All	3.8	36.8

There is here a clear differential relationship between occupational class and family size, and between occupational class and test score. There is also an almost perfectly inverse correspondence of test score and family size between occupational classes. These relationships suggest that the negative correlation between fertility and intelligence may be a function of differences between social classes. But further analysis of the survey data showed quite clearly a negative correlation between family size and intelligence test score *within each occupational class;* and these negative correlations were only a little smaller than that obtained for the survey population as a whole.

Thus a third element, social class, must be added to the fertility-intelligence differential. Though the Scottish Survey data do not completely represent the whole adult population, as childless couples are omitted and large families over-represented, it is likely that the differences between social classes revealed in the survey are a fair enough indication of the pattern in the whole population. This differential relation between intelligence, social class and fertility complicates the prediction of future trends of intellectual level, introducing as it does two further unknowns.

The first unknown element is the stability of the observed differences in fertility and intelligence as between social classes. There are some indications that in Scotland the social class-fertility relationship is in a stage of transition from a fairly uniform distribution of largish families over the various social classes to a more uniform distribution of smaller families over the various social classes, and that this process of reducing family size is more advanced in those social groups containing the more intelligent parents and children. If this supposition is correct, then the expectation would be that the negative correlation between family size and intelligence would be reduced, and what is more important, the number of large families containing the less intelligent children would become less.

The other unknown is the trend of social mobility between classes, and its effects on the intelligence-fertility relationship. There are grounds for believing that the fertility of parents whose social level has changed is intermediate between that of the class they are in and their class of origin. In the Scottish Survey, of the 6 per cent of children with highest test scores, nearly one-third were children of skilled manual workers, about one-sixth were children of professional men and large employers, and about one-seventeenth were children of unskilled manual workers. These children are estimated to be able to attain a University standard of education, and some may move to a different social class. Some of the children may remain in the class of manual workers. On the other hand some of the less intelligent children from the professional class may also manage to remain in that class. Whether the differential fertility of social class or the differential fertility of intellectual level will prevail remains unknown, but any estimates of future trends in the population must take these possibly conflicting influences into account.

Height and Weight

The heights and weights of the children in the 10 per cent sample were recorded, as well as their intelligence test scores. The pattern of the relation of height and weight with family size, and with occupational class, resembles closely that of intelligence test score, though the correlation of height and weight with test score is only of the order of $r = +0.20$ to $r = +0.25$.

Since records for height in particular are more extensive than those for intelligence, it is tempting to construct a model, using height instead of intelligence, and to test prediction from the model. The correlation of height with family size is a little smaller than that of intelligence with family size, and the differential relationship of height with social class only a little less marked than that of intelligence. What, then, is happening to the average height of the population? During the years between 1932 and 1947 the average height of Scottish children increased; and records from certain parts of Scotland show that this increase has been in progress since 1910 and is still continuing. There is evidence that a differential relationship between height and social class existed in 1910, and indirect suggestions that the differential relationship with family size also existed, though this latter cannot be established independently of social class. Children at school in 1910 are likely to be parents of children measured in later years, so it seems reasonably certain that, age for age, the children are taller than their parents. Further, the average height of the adult population does not seem to have altered to any marked degree over this century, and no evidence of a decline has been adduced. It appears possible, therefore, for a stable level of height to exist in the context of a differential corespondence between height and fertility, and height and social class. Though the environmental influences affecting height may not be the same as those affecting test score, it is not

easy to conceive of a situation where the relationship of two variables with fertility and social class are closely parallel, and yet where for one (intelligence test score) the relationship is accompanied by a decline and for the other it is not. The model for height does not, by analogy, suggest a decline in average intelligence.

Migration

For the purpose of the Survey, Scotland was divided into four types of areas, the four cities, the large towns, the small towns, and the rest of the country, this last being called the Other Areas. The cities and the Other Areas each contains about 40 per cent of the total survey population. For each child in the 10 per cent sample, there was recorded the place of birth and of present residence, both in terms of the four types of area mentioned above. About 11 per cent of the children were migrants. Those migrants were found to be a superior group, intellectually, socially, and physically. Considering the cities and Other Areas only, the average test score of children migrating from the Other Areas to the cities is 7.1 points higher than that of the children migrating in the opposite direction. The average score of all children born in the cities, whether migrating or not, is 1.5 points higher than that of all children born in Other Areas. During the eleven years of the survey children's lives, 1936 to 1947, there appears to be a definite flow of intelligent children, in smaller families, to the cities, and a corresponding flow of less intelligent children in larger families to the Other Areas. Because of the miscellaneous kinds of districts defined as Other Areas it is not possible to make anything but very rough estimates of the results of this trend, but it does seem that if the loss of intelligent children from the Other Areas had continued for any time at the rate indicated by the 1947 Survey, the difference between the average test scores of children born in cities and born in Other Areas would be much larger than it is shown to be. The explanation may be in social terms, or it may be another apparent paradox, that the Other Areas are continuously losing a proportion of the more intelligent children to the cities and receiving a proportion of the less intelligent children, but that the average intelligence in each of the two areas appears to continue at very much the same relative level.

Conclusions

This paper has confined itself to a discussion of the results of the Scottish Mental Surveys only. The findings of the 1947 Survey on the relations of fertility, intelligence test score, social conditions and stature are in substantial agreement with the findings of other corresponding investigations and raise much the same questions. Comparisons of the intellectual level of a given population over a period of time show somewhat more conflicting results, and the non-committal conclusion that there is no evidence of a fall in average intelligence appears to be the most fitting one. The positive contribution of surveys such as the Scottish ones is to reveal the nature and extent of the problems rather than to find conclusive answers to them, and to provide a framework of reference for more limited but more intensive investigations. Such investigations could profitably be directed to the elaboration of more precise methods of handling sociological and genetic data, to the establishment in greater detail of the interaction of social and genetic factors in fertility and intelligence, and, as the Scottish Mental Survey is doing with the 1215 individually tested children, trying to ascertain the bearing of intelligence test score, family size and social conditions on the future lives of the children. The main need, however, is to establish a link between one generation and the next. Neither extensive surveys nor limited investigations are themselves alone sufficient; the two approaches are necessarily complementary to each other.

THE MYTH OF THE MELTING POT
Genetic Variability and Racial Intermixture

DAVID C. RIFE
ELTON F. PADDOCK
Institute of Genetics
The Ohio State University

MYTHS ARE FICTIONAL LEGENDS, but more often than not they carry elements of truth. Popular beliefs concerning the results of racial mixture may be classed as the myth of the melting pot. According to this myth, the mixture of races is analogous to the process of manufacturing alloys. There is actually a great deal of truth in this analogy, although the true nature of alloys is frequently misunderstood.

When molten copper and zinc are thoroughly mixed in the proper proportions, brass will be produced. Brass, bronze, and other alloys are intimate mixtures of two or more pure metals. The ideal alloy is one which combines the desired qualities of two or more metals in what *appears* to be a homogeneous blend.

The appearance of homogeneity is superficial, however, as the alloy is essentially a physical mixture, not a chemical compound. Brass, for example, is a mixture of particles of pure copper and pure zinc, the size of the particles varying from atoms to tiny crystals. The result of a mixing of two races is analogous to the metallurgical melting pot in that the mixing does not result in the elimination of variability. It differs in that the end product in the human melting pot is a grosser mixture, the variation within mixed populations being more readily visible than in the metallic alloy. Concepts to the effect that either type of melting pot produces a new homogeneous product are purely fictitious.

The myth of the human melting pot is founded on the assumption that the hybridization of different human populations will eventually result in the elimination of biological differences. According to this way of thinking mankind will eventually be characterized by a uniform shade of skin color, hair form, and various other physical characteristics, which now vary from one ethnic group to another.

There can be no question but that barriers between human races are rapidly being eliminated, owing to modern transportation, education, and communication. Today it is difficult to find "pure" racial groups. In most parts of the world many cultural barriers to understanding and cooperation are on the way out. But what about genetic variability? Is it tending to become less?

The answer is "no." Genes, the particles of heredity, do not lose their identities but maintain them over an indefinite number of generations, regardless of what other genes they may be associated with. This principle is the essence of the classical discoveries made by Mendel almost a century ago. Mixture of races neither increases nor decreases the total genetic variability in mankind. It brings about an increase of individual variability.

Mixtures of Negroes and Whites provide an excellent example of this principle. The first generation offspring are intermediate or mulatto. But if these mulattoes marry other mulattoes of similar origin, their offspring will exhibit subtly varying degrees of pigmentation, ranging from the dark brown of Negroes to the light pigmentation of Whites. The genes have maintained their individuality from one generation to another. The mixed population will have much greater variability with respect to

pigmentation and other traits than do individuals among unmixed Whites or Negroes. Also, there will be new combinations of characteristics between individuals not found within either parent population. Some of the mixed individuals may possess light pigmentation and very curly or kinky hair, while others are characterized by dark pigment and straight hair. It will be seldom indeed that the hybrid population will have individuals possessing *all* Negro characteristics, or *all* the characteristics of Whites.

Genetic segregation for differences will continue from one generation to another within the hybrids. Thus instead of the human mixture combining two types into one, it produces greater variability than present in either of the parent populations. The hybrid population is an obvious mixture. Unlike the metallurgical melting pot, the ingredients do not melt and fuse to the degree that the product appears to be uniform. The mixed human population likewise differs from a mixture of different colored paints, which form one apparently uniform color, the exact shade depending upon the proportions of each in the blend. Rather, it is like a mixture of different colored marbles, each of which maintains its color unchanged.

A bag of black marbles may be thought of as the pigment genes in one parent population, and a bag of white marbles as those of the other. If the marbles from both bags are dumped into a bowl and mixed together, we have the same degree of variability within the bowl as there was between the two bags before.

Mixtures of population shift the variability from groups to individuals, but the total variability remains constant.

If one stands at a sufficient distance from the mixture of marbles, he will no longer be able to see the individual marbles. Then the mixture will appear to be one uniform color. This is much the same as with alloys and paints. The point is: do we contemplate the particles or the mass?

With man, it is the individual with whom we must deal. Yet we are able to characterize man in the mass by the abstractions of statistical averages. We can demonstrate differences between populations with this device. But the most important thing about an average is the variation in the group of individuals from which it is calculated. Particle-to-particle differences within a mixture are always greater than within the substances that entered the mixture. This is true whether we cannot see the particles as in an alloy or paint, or whether we have difficulty visualizing the mass as in human populations. Thus mixing does not alter the original differences between the particles. It only shifts the average and increases the variation associated with said average.

When the relative proportions of the parent populations and the mode of inheritance of a trait are known, it is possible to calculate the distribution of variability within a hybrid population, provided that the traits in question do not play a part in the selection of mates. Suppose we assume that 10 per cent of a hybrid population is of Negro descent, and the rest White, and that Negroes and Whites differ in four genes with cumulative effects on pigmentation. Random mating would bring the distribution of these genes to a stable equilibrium, which would be maintained at this same level from one generation to another. The individuals in the hybrid population may be compared to bags each containing four marbles. If a bowl contains 900 white marbles and 100 black ones and they are thoroughly mixed, and the marbles are then placed in the bags at random, the frequencies of bags containing all possible combinations of black and white may be easily calculated. Bags containing 4 black marbles represent individuals characterized by "black" skin, those containing 4 white marbles represent those with "white" skin, and the other three combinations represent intermediate shades. Approximately two-thirds of the individuals would lack Negro

genes, about 5 per cent would be mulatto or darker, whereas only 1 person in 10,000 would have only Negro genes and therefore would be as dark as their Negro grandparents. As there appears to be no dominance with respect to skin pigmentation, these proportions would be reversed if the parent populations were comprised of nine-tenths Negro and one-tenth White. But hair form, skeletal dimensions, and other variations appear to be inherited independently of pigment, so the occurrence of individuals possessing all the characteristics of the parent race would be far less than for pigment alone. There would be numerous degrees of variability, and the originally sharp contrasts between the parent populations would be largely eliminated. The belief that racial mixture eliminates or even reduces genetic variability is a fictional part of the myth of the melting pot. Mixture scatters variability, but the total amount remains constant.

There is still more fiction to the myth. We shall briefly discuss two more common misconceptions, rather closely related to each other and to the first one. It is often assumed that individual variations with respect to a trait may be due to genetic makeup, whereas such differences between ethnic populations are due to cultural background. While it is unquestionably true that culture may do much to accentuate or to mask the expression of genetic differences, there is no evidence that it has any direct effect on genes. It is axiomatic that if individuals differ with respect to certain genes populations may also be expected to differ from each other with respect to the frequencies of these same genes. Such expectations are borne out by observations of the distributions of genetic traits within various populations. Table 1 shows the ABO blood group distributions in several populations.

TABLE 1

	O	A	B	AB
U. S. (Whites)	45%	41%	10%	4%
Chinese	45%	25%	25%	5%
Egyptians	32%	35%	25%	8%
Peruvian Indians	100%	0	0	0

Several other blood group series are known in man, each inherited independently of the others. These also occur with different frequencies among various racial groups. All other genetic variations which have been investigated in man follow the same pattern. These include fingerprints and handprints, skeletal dimensions, pigmentation, hair type, inherited abnormalities and disease susceptibilities, and numerous other conditions.

Occasionally two different ethnic groups may have similar distributions, with respect to a trait, but this is so rare that it appears to be happenstance. While two distantly related populations may happen to be similar in one trait, none have been found to be alike with respect to all genetic traits, nor will all human groups be alike with respect to the *distribution* of any one genetic variation.

As a matter of fact, the degrees of similarity with respect to the distribution of a number of different genetic traits provides the basis for evaluation of degrees of group relationship. The more closely two populations are related the more ancestors they have in common, and consequently the greater will be their genetic similarities. A racial group is in a very real sense a big family, the members of which are less closely related than those of more intimate family groups, but more closely related to each other than to members of other racial groups. Evidence that individual differences are due to genetic makeup may be accepted as evidence that populations also differ with respect to the distributions of the genes involved. This principle is of special concern with respect to mental and personality traits. It is frequently pointed out that comparisons of the psychological test scores of different ethnic groups mean little because such tests do not take into account the differences in cultural background.

While there is undeniably a great deal of truth in the criticism, it must be remem-

bered that evidence for individual genetic differences within a group must likewise be accepted as evidence that the groups as such also differ with respect to the frequency of genes governing these traits. This does not tell us what the nature of these group differences is but simply indicates that they are doubtless present. There is valid ground for debate as to the reliability of evidence of an hereditary basis for individual differences in mental and personality traits. But if one accepts such evidence as convincing, then he is forced to conclude that populations differ with respect to the distributions of these same traits.

The third fictional portion of the melting pot myth has to do with the concept of culture. The ability to develop cultures is perhaps man's most unique characteristic. By means of language and the use of tools, he has transcended the bounds of biological inheritance. Culture may be considered social inheritance, by means of which we are able to profit by the cumulative knowledge and experiences of the race. Culture is apt to be thought and spoken of as a type of group environment, which in a sense is true. But the *ability to develop* a culture most certainly is genetic in origin. Such a change was surely a major one, and what we know concerning the evolution of major differences leads us to believe that many rather than few mutations have occurred and that they are probably still occurring with reference to this ability. One is forced to conclude that there are genetic differences within mankind as to the types of culture which various ethnic groups are capable of developing. Thus it is erroneous to conceive of culture as being solely an environmental phenomenon. Like most human variations, it is an end product of heredity and environment. It should also be kept in mind that differences in kinds of culture need not imply that one culture is superior to another. What is best in one environment might be worst in another.

To sum up, modern trends toward greater racial intermixture have no effect on the total amount of genetic variability within mankind. But they are rapidly shifting the distribution in such a way as to bring about an increase of individual differences and a filling in of the differences between populations. Culture may alter the expression of individual genetic differences within groups, but the genetic potentials are unchanged. Finally, the ability to develop a culture is conditioned by genetic endowment, which leads to the conclusion that racial groups most likely differ with respect to it.

Whether for good or bad, further increase in the degree of ethnic intermixture appears to be inevitable. Perhaps in the long run it may be good. Scattering of genetic variability and reduction of sharp differences among racial groups enable better acquaintance with our neighbors throughout the world. But it also means that educators, statesmen, and social workers must pay more attention to individual differences than they have in the past. Individual differences seem bound to increase, not only on account of the breaking down of ethnic barriers but also due to the fact that natural selection is becoming less and less effective in eliminating the biologically unfit.

In order to get along in our highly integrated world, we must have some understanding of our fellow men. This necessitates greater appreciation of the biological basis of human nature. In the new atomic age we cannot afford to do otherwise. We must face the challenge of facts which cannot be altered by any amount of wishful thinking.

Retrospect: World Population Conference

The World Population Conference was held in Rome from August 30th to September 10th of this year under the auspices of the United Nations with the collaboration of the International Union for the Scientific Study of Population and the interested special agencies. This Conference was, in the words of the Secretary General, the largest meeting of scientists ever held under the auspices of the United Nations.

There was good reason for so large a meeting. The conference was concerned not only with demographic statistics but also with the inter-relation of population trends with economic and social development, with the use of resources, with biological heredity and population genetics, with the relation between fertility and intelligence, with legislation and services relevant to population change, with migration, and with the control of mortality and fertility. The significance of current trends in mortality, fertility, marriages, and migration had drawn together men and women from all the scientific disciplines concerned with the study of man, including economics, conservation, anthropology, sociology, psychology, biology and human genetics, medicine, and public health. There were in all some 660 participants and contributors, as well as observers and members of the press. They came from 44 nations, including 7 representatives from countries behind the iron curtain.

The meetings were held in the spacious conference rooms of the FAO, equipped with ear phones and provided with simultaneous translation by the interpreters of the United States. The attendance at the public meetings ran between 200 and 300 and at the technical meetings, which were held at the same time in a smaller conference room, between 150 and 200. At the general sessions held at the beginning and end of the conference there were never less than five or six hundred present. So large an attendance demonstrated a keen interest on the part of the participants, many of whom were foregoing their first opportunity to see the sights of interest in Rome.

There was little publicity and no startling announcements. The aim was a thorough scientific examination of the trends in population of the world today, their determinants and consequences, and their bearing on major problems facing the United Nations and the member states; and to bring about among the participants a better understanding of the interrelationships of their various disciplines. In both of these aims the conference was, we believe, immensely successful.

The greatest change of recent times has been the extension of human life. In the countries peopled by Europeans, expectation of life at birth has almost doubled in the past hundred years, and the possibility of a similar increase in the life span has been demonstrated in a number of the less developed countries. Probably no other advance promises so much for human happiness. It was natural, therefore, that the conference should give its first attention to trends in mortality in areas both of lower and of higher death rates. But if all mankind is to be permanently endowed with an average length of life of 70 years or more, the high fertility of the past must be reduced, or else at some near or distant point life would lose its value in a too crowded planet. Fertility was, therefore, the next subject of discussions: What are the present trends of low and high fertility, and what, for both areas, is the probability of change?

Pressures of population growth are among the causes of international and of internal migration, and these subjects occupied three sessions of the conference, together with accompanying problems of industrialization. Changing age compositions due to the lowering of mortality have economic and social consequences of no mean order, and these were considered at two sessions.

Finally all these problems lead up to the demographic aspects of economic and social development, which were discussed in four sessions. The first considered the problem of population and resources, the second that of population and agriculture, the

third that of the relation of population to capital formation, investment and employment (a subject of special interest to such institutions as the World Bank and all government planning agencies), and the fourth, the inter-relation of population, economic development and social change with special reference to programs for underdeveloped countries.

Two sessions on biological change indicated the speed with which new avenues of approach are being opened in the study of the effect of population changes on the distribution of genetic factors, and considered the relation between fertility and intelligence. The representatives of the Communist countries contended that permanent biological changes were brought about solely by changes in the environment, and they denied the existence of the genes which are the postulates of modern genetics. But this view was not supported by the able group of human and plant and animal geneticists who were present. It was the general view that differences in mortality and fertility, assortative mating, migrations and other factors—many of them under human control—affect the distribution and frequency of various genes, and that these in turn play a large part in determining the differences which are found between human individuals.

Paralleling these sessions were a number of meetings deveoted to technical problems of materials and methods of demographic study and research. Finally on the last day of the conference two meetings were devoted to a summary of the findings on the outlook for world social implications of population trends.

Over 300 papers were prepared for presentation to the 28 working sessions of the conference. These papers were mimeographed and circulated to the discussants some weeks in advance. It was, therefore, not necessary to read the papers at the meetings, and there was time for full discussion. At most of the meetings there was general agreement on a number of findings, and the rapporteurs were able to report not only the principal points in the discussions but also a set of general conclusions arising out of the meeting. The reports were circulated on the last day of the conference, and after correction by the participants in the various meetings, the rapporteurs will prepare them for final publication. It is hoped that the first volume of the proceedings containing these reports will be published shortly in a single volume of about six-hundred pages, making available, soon after the end of the conference, a summary of the conclusions reached in the various meetings. This publication will be followed by a complete documentation containing in a number of volumes, all of the papers presented at the conference and the more important discussions.

The conference was financed by grants from the United Nations and the Italian government, and grants from individuals and foundations. From a small surplus remaining and an expected additional grant, money will be available to supplement the provisions of the United Nations for publication of the proceedings.

The results of the conference should justify the confidence shown by these generous contributors. In the words of M. Sauvy, the eminent French demographer: "Without pretending to solve the world's problems, the World Population Conference of 1954 has laid a sound base for the weighty discussions now arising on these subjects in every country of the world . . . Bringing together scientists of diverse disciplines . . . it should make a discreet and telling contribution, directing men's interest away from wars toward the struggle for a better life."

CHANGES IN AMERICAN MARRIAGE PATTERNS

And the Role of Women*

NELSON N. FOOTE
Director, Family Study Center
University of Chicago

IN THE UNITED STATES, generations, areas, classes, and ethnic and religious groups differ widely as to their previous patterns and their rates of change in women's roles within marriage. Nonetheless it seems valid and useful to assert that in general the direction of change is the same among all strata. There are no effective counter-movements, only varying degrees of opposition, hesitancy and venturesomeness, toward development of a wifehood and motherhood characterizable as yet only in the tentative terms or dimensions of a rudimentary prototype.

That such a consistent prototype appears to be emerging in America is a consequence of a battery of powerful common influences, some of which are so comprehensive in their bearing upon social life that they shall only be listed:

1. The equalization of real family income, concurrently with its rapid rise, especially during the past half-generation.
2. The thorough diffusion of favored cultural patterns, through restless internal migration and travel, almost universally enjoyed media of mass communication, and high levels of education.
3. An operative ideal of equality of opportunity, to which every minority or disadvantaged person can make public appeal.

Influences which bear more specifically upon the wifely role will be noted as its salient aspects—and needed qualifications of their generality—are described.

Women of the educated and mostly salaried upper middle class are leaders, models and mentors in moving the public toward the prototype hypothesized. This not unwitting bias accounts for their prominence in the analysis below. No comprehensive survey exists, but citations are available for all statements of fact.[1]

Decline in Economic Dependence

Legal disabilities of women were felled after World War I, but only World War II and full employment since have given them substantial movement into all jobs and toward equal pay for equal work. Recent reports by the Women's Bureau of the U. S. Department of Labor show, among other marked shifts, 27 per cent of all wives in the labor force (1953). A wife's sense of economic dependence upon her husband is in severe decline, even if not working, when she feels she can work if she wishes, and at the cost of no severe decline in status or standard of living.

Married women were discriminated against during the depression; their sense of economic independence may thus depend upon continued full employment, but it may be more permanently structured. To illustrate, successive reductions of the normal work-day and work-week, concurrently abetted by lowerings of time taken up by conducting a household, let many women enter the labor force who

*Presented at the World Population Conference, Rome, September 1954.

[1]Among sources contributing to the general estimate attempted here, the references cited at the end of this article were especially helpful.

could not when job and home each were full-time. Further shortening of the work-day and work-week has general appeal and becomes more feasible as productivity rises. Institutionalization of maternity leave in contracts is also probably durable.

Increased divorce rates in recent decades may partly demonstrate that wives can now leave their husbands with less fear of hardship. From the husband's viewpoint, this may make a marriage more precarious, but to the wife it gives greater power to insist that the marriage be satisfactory. The decline of alimony awards may signify legal recognition of the availability of self-support.

Segregation of the sexes among types of employment and physically at work is diminishing, *i.e.*, men and women are increasingly working together at the same jobs as well as similar pay. The equalization of social status implied constitutes an example to the community at large. Another function of co-employment is exposure of women to a wider range of potential marriage (and re-marriage) partners, thus further reducing male advantage and strengthening the wife's position. Some husbands complain frankly to interviewers that working wives are hard to control, yet women ever married in the labor force have doubled since 1940.

More Financial Responsibility

Due mainly to the mounting kinds and degrees of wives' contributions to family income, but aided by increasing male confidence in their judgment, the earlier pattern of predominant male voice in expenditure is giving way to varied arrangements. Wifely participation in determining expenditures is less often through adoption of a rigid division of income and more through discussion and repeated readjustments. A substantial minority handle all family accounts.

Among urban white-collar groups, wives contribute especially heavily to family income during the earliest years of marriage. Some married students are totally supported by wives while completing their educations, without embarrassment. Whether cause or effect of earlier marriage, parents of both are freer in aiding young couples. The traditional sentiment that the new husband must support his wife as her father did has attenuated in nearly all strata, in favor of a desire by wives to share in their husbands' upward financial struggles. The evidence is chaotic but suggests that wifely income, while no longer conceived as pin money for purchasing extras and luxuries, has not, except in poor families, become yet quite as essential as the husband's. Being lower than his as a rule, it still tends to be conceived as supplementing and stabilizing his. Nevertheless, as already experienced by some couples, when her earning power comes close to his, its loss due to pregnancy can be quite destabilizing in the absence of a prudent schedule of saving and expenditure. Taking this into account makes the heaviest incidence of the baby boom among white-collar couples even more hard to explain but strengthens the expectation that these women may want to resume work, unless their husbands' incomes continue to rise rapidly.

Public recognition of the variability of these arrangements is found in the law which permits husband and wife to decide each year to file separate or joint income tax returns, and to claim appropriate allowances for dependents. As a time for self-conscious review and planning, this filing period invites scrutiny for understanding decision-making on income, expenditure and fertility.

More Sharing of Authority

Participation by wives in family decision-making extends beyond financial matters and is being enhanced by a variety of influences other than economic. Along with easing of legal barriers to divorce, the sanction of public opinion against it as shame-

ful has crumbled. Three-fourths of the divorced soon remarry. As an ultimate defense against unilateral assertion by husbands, wider availability of divorce conditions all marriages. Whether it does so by causing mates to try less hard to master crises, or whether relationships are improved by the limitation of male authority, is unfortunately a much-debated issue as yet unsettled by research. Several studies summarized by Goode agree on a substantial inverse correlation between economic status and frequency of divorce, with professional groups—the most equalitarian—divorcing least.

Male pretensions to superior authority are widely ridiculed in contemporary comedy, cartoons, children's literature and other forms of popular art. Patriarchal enclaves are steadily dissolving through acculturation. The common encouragement of adolescents to achieve independence tends to focus on fathers and tempers young adult male performance in turn. Masculine domination through greater physical strength, corporal punishment and open violence have diminished in even the most patriarchal strata, perhaps indirectly due to decline of occupations demanding arduous manual labor and the rise of those rewarding education and social skill. Several surveys turn up men wanting their wives to be less dominated than their mothers were, none wanting the opposite.

The role of the wife in sharing authority is concurrently being strengthened positively by her higher education, wider contact outside the home, the exercise of responsibility in civic associations, and explicit encouragement by "experts." The increased emotional intensity and psychological interdependence on which observers agree, resulting from the small family's isolation from kin and parents, make the giving and withdrawing of affection a potent sanction of sharing. It is significant here that upper occupational groups are the most migratory save farm labor.

Less Division of Labor

A more or less pronounced differentiation between male and female tasks in the home has traditionally been regarded as a fundamental feature of family organization. But in those marriages among the urban, educated classes which have been taken as prototypical of change in all strata, there remain only two or three tasks securely monopolized by one sex, childbearing and sewing by the wife, and the most arduous physical maintenance chores by the husband. Painting, repairing, fueling, car-washing, though still mainly performed by husbands, are increasingly undertaken by wives, often with their husbands, often alone. Wives in rural and lower classes have often performed men's work, but more fortunate women have both avoided and been denied it. Such women are losing their inhibitions against it, concurrently with abandonment of restraints upon participation freely with men in physical play and sports. Sport clothing, in fact, is commonly the garb of suburban wives in such tasks, and their attitude corresponds.

On the side of the husband, the same crossing of ancient boundaries is fast becoming commonplace among the more culturally-alert and servantless segments. Diaper-changing, dish-washing, cooking, cleaning, laundering, shopping—tend to become duties shared with the wife, especially when she works outside. Such sharing fluctuates, rotates and changes unevenly, frequently provoking conflict. If sewing were not in severe decline generally in American homes, husbands might have invaded even this province; the main restraint against it has been implicit loss of masculine standing if they do so before public opinion legitimizes it. Thus American wives, between mechanization of the smaller home, factory-provided services, and husbandly assistance in their chores, are progressively relinquishing a traditional *raison d'être*, but are gaining greater

companionship with their husbands and more freedom for leisure pursuits than they are fully prepared to utilize. Some resent this trend as somewhat a usurpation of their prerogatives, especially child-rearing, some feel bereaved of function, but most welcome it.

More Companionship with Husband

Companionship is further advanced in play than in work, either inside or outside the home, save in declining family enterprises like farming and retailing. They attract favorable comment, but very few couples have been able to coordinate their careers and circumvent anti-nepotism rules to work together at the same vocation. But the decline of segregated amusements and voluntary association is pronounced, whereas formerly men monopolized political bodies, women, cultural societies, and adult fraternities and sororities thrived. Coeducation has been a major influence in this trend, great state universities supplying a model.

It appears probable that the urban husband spends more hours per week in the company of his wife than in any decade since industrialism removed production from the home. It is becoming impolite to invite husbands only or wives only to most functions; and agreement upon friends and outside interests now appears as important in marital adjustments as approval by each other's previous families.

In 60 years the median age of males at first marriage dropped from 26.1 to 22.6; of females, from 22.0 to 20.4. Earlier marriage, before the man has achieved financial independence, suggests growing companionship, but the decreasing gap in ages is still more indicative of the comradely relationship arising; this gap will probably decrease further, as will discrepancy in their educations.

For this trend toward the companionship marriage heralded by Ernest W. Burgess, another kind of evidence occurs in the new Kinsey volume on the sexual behavior of American women. It reveals that the frequency of female orgasm in marriage has steadily increased over the past five decades, while the frequency of intercourse has slightly declined, which Kinsey interprets as due to its regulation more by mutuality of desire and less by unilateral male demand.

In terms of sex role and personality rather than sexuality, the extreme polarization of masculinity and femininity found in the past is diminishing somewhat as signified particularly in feminine sports dress and masculine beardlessness.

Recurrent Self-doubt

The rapid change of women's roles occurs unevenly amid conflicting conservative and progressive attitudes and is far from a smooth and confident passage. While the more backward undergo continued suppression, the same trends intermittently precipitate the more forward into mingled emotions of anxiety, guilt, futility, boredom, unimportance, resentment and regret over wasted capacities, punctuated by spasms of housework and "doing things for the family." Such a mixture of intangibles can hardly be captured systematically but has to be reported as a widespread characteristic of contemporary marriage, especially in the prototype groups. Perhaps this is the subjective side of all social change.

A major index is the efflorescence of many facilities for marriage counseling, psychiatry and advice-seeking-and-giving. A perhaps more healthy response to uncertainty about how to encompass the roles of wife and mother, companion and producer, are the flourishing child study groups, family living courses, and popularized scientific publications presenting information and guidance to replace traditional prescriptions. On the most intellectual plane is the wide reading of a dozen postwar books, mostly by women, which delve rationally and exhaustively into their current

dilemmas. A skeptic might ask if these manifestations ameliorate or aggravate the condition they express. Numerous husbands, even the most sympathetic, confess puzzlement over the subtle stresses through which their wives pass as they assimilate alterations in their structural situation.

Husbands, of course, have usually had their vocations from which to derive an unremitting sense of worth (save when embroiled in contests for prestige). But wives in large numbers have become disaffected from marital and familial roles which formerly engrossed them, without having fully arrived at a new self-conception which reconciles their competing aspirations. Until their destination becomes more clearly defined, it will remain difficult for their husbands or peers or the public to furnish the ratification that will quell their vertigo.

An Emerging Developmental Perspective

Conflict in women's roles is not helpfully conceived simply in terms of static dilemmas of career vs. marriage or siren vs. hausfrau. The so-called feminist might better have been called a masculinist when she rejected the conventional feminine role, taking men as her model, instead of seeking to modify and elaborate femininity in new directions. The current trend in both popular and professional thinking is toward the recurrent reconciliation of plural interests in ways peculiar to each phase of the life-history. The concept of career is thus loosening to comprehend more than just the vocational sphere. The career-problem thus tends to be construed as fashioning a wifely role which combines a real sense of vocation on which adequate feelings of worth can be based. A few succeed by developing virtuosity in a household art or knowledge of child development, a few by community leadership. For many more, however, gainful employment seems psychologically indispensable even when not financially necessary. In this career-seeking wives may be more traditional than they suppose, if they cannot grant to leisure pursuits the same validity as paid work.

Much discussion has been focused recently upon the emotional plight of the middle-aged mother whose last child leaves. Lengthened life, earlier marriage, earlier child-bearing, fewer offspring have multiplied and lengthened the emptyest phenomenon. It warns against the limitation of wifely interests to children.

Equally recognized as a grim sanction against the traditional narrowness of female interests is the fairly common spectacle of husbands who "out-grow" wives, who continue to develop intellectually and socially while their wives are arrested in routine, the widening distance and tension between them culminating in divorce when the husband encounters another woman more stimulating than his wife.

These negative sanctions are fortifying the positive values found in maintaining the companionship characteristic of the courtship period throughout the marital career and are commencing to evoke some rational foresight into the conditions for doing so. This may be a new variant of old-fashioned prudence.

Professionalization

This is the best single term for summarizing the interrelated variables and trends which appear most influential in redefining women's roles in marriage: shifts of employment toward tertiary industries and salaried occupations, rise and stabilization of real income, freer access to higher education and skilled employment, more responsibility in family planning, reliance upon scientific expertness instead of tradition, broadening application of the career concept, and self-conscious emphasis upon continuous personal development. It may be relevant that the American Council on Education appointed a Commission on the Education of Women in 1953, to conduct basic research, action studies and educational experimentation relative to the kinds

of women to be developed, and the means of doing so, at all levels of schooling.

Qualifications needed to relate the prototype sketched above to the diverse strata of American society can be roughly summarized under the heading of heterogeneity. While the varying kinds and degrees of resistance to following the example of the professional classes, so far as they are cultural inheritances, can be witnessed dissolving, it would be not an over-simplification but a distortion to assert that heterogeneity is in absolute decline. The ever-more-refined division of labor and the differentiation of avocational interests constitute counter-influences. Pursuit of individuality and versatility appears stimulated by leisure. This effect is especially intensified as parents commence self-consciously to cultivate the distinctive talents and personalities of their children, as many make it the goal of their marriage to do.

Intensive migration and mobility, moreover, tending to throw marriageable persons into cosmopolitan contacts, have multiplied intermarriage and heterogamy. Despite mass communication and engulfment of socio-economic extremes in the middle, no downtrend in the newer modes of cultural diversification is foreseeable. The stability of marriage comes thus to depend less upon homogamous mate selection and more upon adaptability and competence in resolving the divergencies of response and orientation which unavoidably appear in heterogamy. Despite their mistakes and mishaps, Americans view the outcomes of marriage not pessimistically as fate but optimistically in terms of success and failure. It further indexes the matter-of-fact professional approach that they are turning to the schools to provide youth with competence to master family life situations.

Competence, Confidence and Procreativity

Up to here marriage has been contemplated apart from parenthood, yet obviously the coming and leaving of children throw husband and wife into varied new constellations, to generalize about which in the space remaining would be futile. The marked social-psychological contrast between the continued strength of the parental relationship and the tentativity of the marital relationship in many of the same families deserves note, as it may further clarify the developmental perspective mentioned above. The normal parent is fully committed to his child in advance and expects to participate in his development, taking some responsibility for the personality which will emerge. A developmental perspective on marriage likewise emphasizes training rather than selection, potentiality of mutual development rather than compatibility of presenting traits. Spread of this attitude may offer some hope of reversing the long-term trend toward marital instability. The recession of divorce rates each year since their 1946 peak may or may not signify that American husbands and wives are learning to master heterogeneity.

National policy is tending toward the improvement of human resources while public sentiment is increasingly attracted by the values of personality development. That the family is the matrix of identity-formation has never needed less emphasis. As younger people pour into the expanding occupations and acquire the professional competence requisite to full self-realization in work, love and play, their unusual current procreativity is probably a valid index of their confidence that they can surmount the unceasingly problematic situations of the dynamic future world they confront.

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Annual Meeting 1954

American Eugenics Society

A luncheon talk by Frederick Osborn, Secretary of the American Eugenics Society, on "Involving the Whole Community in Education for Personal and Family Living" will highlight the Annual Meeting of the American Eugenics Society, to be held in conjunction with the Conference on Education for Personal and Family Living of the American Social Hygiene Association on December 17, 1954 at the Hotel New Yorker, Eighth Avenue and 34th Street, New York City.

Tickets for the luncheon at 12:30 P.M. can be obtained for $3.50 at the New Yorker Hotel on the day of the meeting without previous reservation. The business meeting of the Society will follow the luncheon at 3:00 P.M. when financial and program reports will be presented. Notices of the meeting are being mailed to all members of the Society.

HEREDITY COUNSELING

Muscular Dystrophy and Cancer

F. E. STEPHENS
Director
Laboratory of Human Genetics
University of Utah

Discussions of problems in heredity counseling are presented in each issue of EUGENICS QUARTERLY.

THE FUNCTION of genetic counseling is to supply, so far as possible, a scientific basis on which the recipients can make intelligent decisions about problems of heredity. Sometimes the facts will discourage the parties concerned from marrying, or at least from having children. In other instances, what seemed to be a threatening barrier to marriage or reproduction is completely removed. There are still other cases where the absence of data on the inheritance of human traits leaves the counselor with little that he can do to help his troubled inquirers. Let us consider some specific problems dealing with different human traits.

Progressive muscular dystrophy is a trait which is receiving much attention on the radio and in the public press. From the standpoint of genetic counseling, several interesting problems are involved. Muscular dystrophy is not just one disease, as is commonly thought, but may be any one of several. The first step, therefore, before genetic counseling can be given, is to secure the proper diagnosis. This can be done best by a physical examination and by a careful study of the family history. The condition of each patient should be diagnosed so far as possible in the light of his family history. Three common forms of muscular dystrophy are Facio-scapulo-humeral (FSH) Muscular Dystrophy, Myotonia Dystrophica, and Childhood Muscular Dystrophy. They all produce muscular wasting for which there is no known cure. In many cases, the only medical diagnosis which will be given by a physician is progressive muscular dystrophy. Since the disease is not too commonly seen by doctors, incorrect diagnoses are sometimes given. Recently a man came to our laboratory, who had been to a clinic in a neighboring state. His case had been diagnosed there as FSH Muscular Dystrophy. When examined here by doctors who were used to seeing many cases of this disease, he was found to be suffering from Spondylitis, not from muscular dystrophy.

FSH Muscular Dystrophy is inherited as a simple autosomal dominant trait. An affected patient with this disease might come to a counselor with such questions as the following: (1) What are the chances of an affected parent transmitting this trait to his or her children? (2) If a person is only slightly affected, can he transmit the trait in a more severe form to his children? (3) If he should marry another affected person, would the children be more apt to have a more severe form of the disease?

In answer to the question, the counselor could tell the patient that since every FSH Muscular Dystrophy patient has one affected and one normal parent, he carries one normal and one affected gene. His child therefore stands an equal chance of receiving either one or the other of these genes and hence may be either affected or normal.

As for the second question—does the severity of the disease in the parents determine the severity of the disease in the children—the answer is "no." A person having the disease in a slight form may transmit

it in a severe form, or the child of a severely affected parent may be only slightly affected.

Because we have no cases where two affected persons have married and had children, the third question could not be answered satisfactorily. It is quite possible that the condition would be much more severe, or even be lethal in the homozygous state, which could be secured only from the union of two affected individuals.

These questions, if asked about Myotonia Dystrophica, could be answered in very much the same manner, except that the counselor would probably emphasize the fact that this disease is a syndrome (a group of symptoms or traits) having a variety of expressions. A person having only one of the symptoms, such as cataract, may have children showing the entire syndrome. The reason for this is not well understood.

In these and other dominant traits, our concern is apt to be centered upon the reproductive ability of the affected individuals only. The question of whether or not normal sibs of the affected individuals might transmit the same disease should also receive careful consideration. Frequently these individuals do not marry or fail to have children because of fear of transmitting a trait which appears in their families or in their relatives. In many cases these individuals are splendid people and should not be deprived unnecessarily of the opportunity of parenthood. An interesting incident which happened in our laboratory emphasizes this point. A man and his wife came to the laboratory to ask about the inheritance of some trait in which they were interested. While there, they asked the counselor if he knew how muscular dystrophy was inherited and referred to a large kindred where FSH Muscular Dystrophy was found. They were told that it was inherited as a dominant trait. This could be said with assurance, since the laboratory has records of seven generations of this particular kindred. They then asked about a young man who came from a family of this kindred, which had several bad cases of FSH Dystrophy. They were told that the young man had been examined twice by an expert and declared free from the disease, and that he therefore was no more apt to transmit the disease than any other normal person in the population. They were quite shocked, since they had induced their daughter to break a marriage engagement with this young man because of fear that he would transmit muscular dystrophy to his children.

With Childhood Muscular Dystrophy the problem is quite different. The disease is inherited as a sex-linked recessive trait and is found in young boys who seldom, if ever, have children. The question is: where did the trait come from, and who can transmit it? The answer, of course, is that the trait came from the mother and can be transmitted by approximately one-half the sisters and by other female relatives who happen to be carriers.

In our records of Childhood Muscular Dystrophy is a family of five children, four boys and one girl. Three of the boys are badly affected, all being confined to wheel chairs. The other brother and the sister are normal. What can the genetic counselor say to the normal brother and sister? He can tell the brother that there is no danger of his ever transmitting this disease to his children. If he had inherited the defective gene, he would have shown the trait. He drew the lucky number. With the normal sister, the situation is different. She may be a carrier. If she is, she may transmit the defective gene to her sons or to her daughters. If the daughters receive it, they will not show the trait but will be carriers. Geneticists can render a very great service by discovering characteristics by which carriers can be detected. So far this has not been possible with sex-linked muscular dystrophy. It is possible in some other traits, however. In Choroideremia, an eye disease, the eye specialists can detect the

carriers by a careful examination of the eyes. Here again, because of genetic discoveries, the counselor might remove the barrier which would prevent many otherwise qualified women from becoming mothers and at the same time remove the doubt about the real carriers possessing the defective gene.

In dealing with sex-linked recessive traits, one must be ever watchful of the females. They seldom show the trait but are the ones who usually transmit it. In our files is the record of a kindred showing a sex-linked recessive trait diagnosed as microphthalmia. In one sibship of this kindred, there were two blind boys and several normal brothers and sisters in 1947. The chances of their transmitting this trait to their children was explained to all of them. Six years later one of the blind boys who had in the meantime been married, called the genetic counselor and said that his wife was expecting a baby and asked what its chances were of being blind. He also said that one of his married sisters, who previously had one normal son and one normal daughter, had just given birth to a blind son. Here is a case where the normal daughter was a far greater risk than her blind brother, so far as the immediate offspring were concerned. None of the blind son's children would be expected to show the trait. If he had a son, it would be normal, without even carrying the defective gene. If he had a daughter, she would not show the trait but would be a known carrier. In the case of the sister, who happened to be a carrier in this case, half her sons would be expected to be blind and half of her daughters would be expected to be carriers.

A more difficult problem for the genetic counselor deals with diseases such as cancer. The nature of the inheritance of a few special types of cancer is understood, but we know little about the genetics of most common forms of this disease.

A woman who has a mother and two sisters who have died with breast cancer appears before a genetic counselor to find what her chances are of developing cancer of some kind. In the light of present knowledge, what information can the genetic counselor give her? While we know but little about the genetics of breast cancer, there are a few things which might be helpful that the counselor could tell her. (1) There is little evidence that she is more apt to develop other types of cancer than anyone else in the general population. (2) Breast cancer is so frequent in the general population that chance alone could account for a few cases of cancer concentration such as found in this family, even if no heredity factor were involved. (3) While present work shows that close relatives of people suffering from breast cancer are slightly more apt to develop this type of cancer than other pepole taken at random from the general population, the genetic mechanism involved is not known. There is not sufficient data available at the present time to warrant a genetic counselor discouraging an otherwise prepared woman from assuming the responsibility of motherhood. While her chances of having breast cancer are slightly increased, other factors than heredity may also be involved; having children decreases the chance of breast cancer.

Genetic counseling needs more data on the inheritance of human heredity traits. These data should be accumulated at the various counseling centers and should be used as a basis for counseling. If family histories are continually accumulated over a long period of time, they will eventually become a most valuable treasury.

In conclusion, we might say the genetic counselor should base his counseling on available data on human genetics, that he should recognize the importance of counseling those free of genetic risk as well as those having risks, and that he should do everything to help accumulate data on human inheritance on which sound genetic counseling must depend.

BOOK REVIEWS

THE DETERMINANTS AND CONSEQUENCES OF POPULATION TRENDS: United Nations, New York, 1954 (Population Studies, No. 17), XII & 404 pp. $4.00.

This monumental work is the creation of four years of intensive study by the exceptionally well-qualified staff of the Population Division of the United Nations Secretariat.

The study was initiated by the Population Commission, which in April 1949 recommended that the Secretariat "should survey the existing scientific studies concerning the relationships between population trends and economic and social factors and prepare a summary of the findings of such studies with special reference to problems of economic development." The volume is therefore intended as a summary and exegesis of existing works, and not as an original treatise on its formidable subject.

Early drafts were reviewed by the members of the Population Commission, who offered suggestions incorporated in the final publication. Vocal criticisms were received from the Soviet representatives to the "reactionary, anti-Marxist" tenor of these drafts and their alleged failure to include the findings of Marxist authors. These and other objections resulted in the inclusion of a fuller bibliography of Slavic literature and perhaps fuller recognition of early French writers in the field who tend to be overshadowed in English-speaking countries by Malthus and his successors.

A more important result of international responsibility and review is the restrained language of the volume. Conclusions are expressed in terms of tendencies, possibilities and probabilities, beliefs, and possible "counter influences of unknown magnitude." A large proportion of the sentences are safely conditional or hedged about with modifiers.

This cautious phrasing is well justified by the lack of scientific knowledge in many of the areas covered by the study. It is perforce an encyclopedia of demographic ignorance as well as of demographic knowledge.

Owing to its substantive comprehensiveness and cautious style few persons will, like the reviewer, wish to read the volume from cover to cover. Most will find it of continuing usefulness as a reference book to be employed as an encyclopedia of knowledge on the subjects covered. The exhaustiveness of coverage is suggested by the fact that there are 2443 footnotes citing almost as many titles included in the 50-page bibliography. The editing and bibliographical work, incidentally, are of outstanding quality.

The purpose of the study is to consolidate existing knowledge (1) for the use of the policy-maker and public concerned with economic and social problems, and (2) to identify gaps in knowledge that most urgently require further empirical study.

It is less successful in achieving the former than the latter purpose. Few policy-makers can be expected unaided to understand or to translate into policy terms the mass of conflicting testimony recorded in this volume. It may serve to alert them, however, to the extreme complexity of the problem and hence enable them to avoid the pitfalls of over-simplified judgments in this vital area. A summary more suitable for the general public is now being prepared by the United Nations staff.

The study is an invaluable aid to further research in the field. Any student embarking on scientific inquiry in demography will ignore this work at his professional peril. The reviewer has already been saved many hours of unproductive toil by turning for reference on sources to the appropriate sections of this text.

Organization of the volume is systematic and perhaps a little more logical in theory than in practice. That the authors regarded the scope of the volume as roughly coincident with the total field of demography is suggested by the scope of the opening chapters on world population growth and the history of population theory. The second major section reviews the economic and social factors affecting mortality, fertility, migration, population growth and age structure, future population trends, and population distribution. The third section turns the causal nexus about and reviews knowledge on the effects of population size and change on labor supply, consumption and output. These are synthesized in separate chapters on the implications of population trends, firstly, in industrial countries and, secondly, in under-developed countries, and looked at from still another angle in a chapter on the economic effects of major migratory movements in modern times.

While the subject coverage is impressive, it should be noted that there are major areas of demographic interest not covered, partly by definition and partly by neglect. In the first

category are the political factors influencing and influenced by population trends. Conspicuous by its absence is any discussion of the demographic effects of war, and conversely of population factors as a possible cause of international tension. There is no discussion of population pressures against international boundaries or of the crucial role of migration policies in determining the volume and character of international movements.

Also understandable, though less justifiable, is the purely perfunctory and fragmentary treatment of social factors, which occupies roughly 15 scattered pages in a text of over 300. Studies in this field are likely to be particularly speculative and subjective. On the other hand, elements of social structure and motivation may well be even more crucial than economic factors in determining population trends in underdeveloped areas, a subject of special concern in this report.

The authors may be excused for omitting qualitative aspects of population, and especially genetic aspects, in a report on "Relationships between Population Changes and Economic and Social Conditions" for official consumption. As a result differential fertility is treated only as an *effect* and not as a *cause* of economic and social trends. But eugenists may properly regret this all-too-characteristic bent in current demography.

It is an evidence of the activity of the field rather than the fault of the authors that the study is already out-dated on some subjects by publications appearing since its compilation. This is especially true of the discussion of the relationship between population and resources. The treatment of international migration also suffers somewhat by the lack of reference to the ten monographs published since 1950 by the Research Group for European Migration Problems.

Despite the limitations of the UN survey it would be difficult to overstate the importance of this reference work to the science of population. A science must build on what has gone before. Especially in an interstitial field such as demography it is becoming increasingly difficult for the individual researcher to cover the wide literature relevant to his inquiries. The UN study will be of the greatest assistance both in identifying the significant problems for research and in quickly reviewing what has already been done.

DUDLEY KIRK
The Population Council, Inc.

CLINICAL GENETICS: Arnold Sorsby, Editor; C. V. Mosby Co., St. Louis, 1953, 603 pp. (incl. index), $17.50.

As the first general textbook of medical genetics in English, this work should fill a very great need. At the same time it will furnish a valuable example to prospective writers or editors of future similar texts.

In the style of most modern medical textbooks, the thirty-four chapters and sub-chapters are contributed by thirty-one different authors. Under this system, of course, continuity and uniformity are difficult to achieve, and the chapters differ considerably in their apparent purpose. At the present time very few people are fully trained in both genetics and medicine, with the result that many chapters in such a book are necessarily deficient in one or the other. However, many of the chapters have been written by recognized authorities in the respective fields, and most of the authors are well known to human geneticists.

In general, the book seems to be addressed to clinicians doing research in genetics rather than to practitioners. This is especially true of the overly documented first section on "Theoretical Considerations." Most of the clinical chapters, also devote considerable space to controversial or frankly academic points. The casual reader will not readily find simple answers to his simple questions, especially when the answer is: "Nobody knows." Exceptions in this regard must be made for the chapters on skin diseases and eye anomalies. Most useful for ready reference is the five-page table of Neel summarizing data on carrier states in thirty-three disorders.

The book is very well illustrated with photographs, diagrams, and pedigrees. The index quite commendably gives subtopics to explain every page reference, but in many instances the subtopics are all on the same or adjacent pages and therefore unnecessary. Many items of information, especially in the theoretical section, are not indexed at all.

To a large extent, differences in emphasis and organization between chapters reflect differences in the subject matter, but some chapters illustrate features which, to the reviewer, seem especially commendable. The opening chapter, by Sorsby, presents some concepts of clinical genetics that are important for both clinicians and geneticists. The chapter on biometry is essential and probably should be expanded, at least in terms of the variety of problems covered. The chapters on muscular disorders (Stephens)

and mental deficiency (Böök) are exemplary in their presentation of the clinical point of view; both restrict historical and theoretical discussion to an adequate minimum. Chapters that seemed to present good critical reviews were those on psychiatry (Slater), morphology and physiology (Tanner), heart disease (Herndon), the alimentary canal (Carter) and cancer (Gorer). The chapter on cancer is one of the few that give sufficient attention to alternative, nongenetic explanations of the disease in question.

Eugenic problems are introduced in the chapters on mental deficiency, cytology, mutation, and genetic carriers. Professor Crew of Edinburgh closes his chapter on mutation with a discussion of the probably increasing frequency of mutant genes. He concludes that, "If this is so, it follows that the only means by which the effects of the genetic load of disability can be lightened permanently and securely is by the protection of the population from radiation hazards and by coupling the ameliorative procedures of medicine with a rationally directed guidance of reproduction."

On the subject of large-scale sterilization of mental defectives, Dr. J. A. Böök of Uppsala writes: "Whilst sterilization does not need to be imposed to avoid a [genetic] catastrophe, it may still be justified for other reasons. Mental defectives are not able to care properly for their children and this may warrant sterilization. There is a genetic indication for it in the case of two normal parents who have a child with an apparently genetic condition and the risk for subsequent children is substantial. Naturally such sterilizations can be on a voluntary basis only."

A rather amazing statement appears in the chapter on infectious diseases to the effect that "in man . . . there are no true races." There is much legitimate debate about the number of races that should be distinguished in man, about their purity, and about the comparability of human races with subdivisions of other species, but there can be no doubt about the *existence* of races in man. After all, the word was originally used to designate the apparently different groups of men, and therefore, by definition, at least some of these groups must be true races.

With the reservations appropriate to almost any first edition, this book can be recommended as an up-to-date reference for clinicians interested in genetic research and for geneticists interested in hereditary diseases. Except as current research changes the state of genetic knowledge, a substantially better book on the subject cannot be anticipated for several years to come.

Gordon Allen, M.D.
Research Division
National Institute of Mental Health

Free and Unequal: Roger Williams, University of Texas Press, 1953, 177 pp., $3.50.

The thesis of Professor Williams' book is that liberty and democracy are based, not upon the equality of individuals but rather upon their inherent *inequalities* in "important" characteristics (This reference to "important" characteristics is repeatedly made but never defined in the book.) This thesis is strongly set forth in the opening chapter.

Professor Williams then goes on to describe a vast array of characters in which people differ, covering such features as handwriting, car driving, likes and dislikes, goals and desires, metabolic patterns, etc. Although it is not specifically stated in each case, the general inference is drawn that much of the described variation is inherent or genetic. Certainly the main theses of the book are based upon important differences being inborn, and consequently, it seems valid for the reader to assume implied genetic differences where the author makes no statement to the contrary. For most of the variability described, there is little or no evidence available on this question, and in this respect the reader may be led factually astray.

The last half of the book is devoted to a discussion of the applications and a plea for the understanding of the many and varied differences in human beings that Professor Williams has been describing. Although nothing unique is involved here, this section is the most worth while and valuable of the book. The idea that the understanding of our differences will lead to greater inter-personal and inter-group harmony can certainly stand re-emphasis. Also stressed is the application of the understanding of our biological differences in medicine where, for example, it is important to realize that because of these differences not all patients can be expected to respond to the same therapy. In the field of education, where Professor Williams has had considerable experience, the necessity of considering both in counseling and placement the differences in talents and interest of different students is given a detailed and interesting treatment.

Let us now consider critically the central idea of Professor Williams' book: the dependence of liberty and democracy upon important inherent

differences in individuals. The point is repeatedly made that liberty is meaningless without individual differences and, more specifically, inherent differences. Williams' argument is that if we were all identical, then freedom and liberty would have little significance, since we would all be of the same opinion, enjoy the same status, etc. While this idea may be intuitively appealing, it will not hold up under analytical consideration. For regardless of our homogeneity, freedom could still be denied. However, this is a minor point; the real source of dispute lies in the term *inherent*. Even granting that individual differences are necessary for liberty, why must they be inherent? Are environmentally induced differences any the less real than genetic? Should a genetically predisposed musician be given more freedom in his choice of pursuits than an environmentally inclined one? It hardly seems like a democratic point of view to adopt. If environmentally produced "important" variations were generally easily changeable and inherent or genetic differences were generally rigid, this would perhaps then be a defense for Professor Williams' view, but as he knows, and even states in his book, this is certainly not the case.

As to Professor Williams' argument that democracy is based upon inequalities between individuals and that democracy allows for the greatest expression of these differences, I fear that I must again disagree. Certainly Plato's Republic, which could hardly be called a democracy, was based upon inherent differences in individuals, and, at least in Plato's eyes, his Republic permitted the maximum expression of individuality.

It seems to me that if Professor Williams persists in using inequalities and differences between individuals as an argument for a particular form of government, he will find that he is arguing neither for democracy nor oligarchy but, essentially, for anarchy.

STANLEY GARTLER
Institute of Human Variation
Columbia University

NATURE AND NURTURE—A MODERN SYNTHESIS: John L. Fuller, Doubleday Papers in Psychology, Doubleday, N. Y., 1954, 40 pp., $.85.

It is a satisfying and encouraging experience to read this paper. The science of genetics has made much progress since the days when the litter of three black rabbits and one white one explained everything worth knowing. Unfortunately, too little of the progress has been made readily available to the layman.

Here is a sober, well-written paper which summarizes clearly the implications for human affairs of the present state of our genetic knowledge and does it with discrimination and humility. Emphasizing the interaction of genotype and environment, quantitative inheritance and multifactorial or polygenic systems, the author evaluates what we know of the nature-nurture problem and wisely points out those areas where our knowledge is still incomplete and where suspended judgment is the only prudent position to take.

"In bringing this paper to a close," Dr. Fuller writes, "the author is aware of a sense of futility in attempting to summarize the nature-nurture problem in a few terse factual sentences. Many statements which he has made should have been more hedged with qualifications than was possible in a brief account." This is undoubtedly true. The problem cannot be exhaustively treated in thirty-one pages or in one hundred pages. There are some important recent developments which the author ignores entirely. Nevertheless, this pamphlet is a valuable and much needed contribution to the semi-popular literature on the subject and Dr. Fuller deserves sincere congratulation. There is a short, inductive bibliography which should give anyone who is interested a toe hold for further reading.

JAMES C. KING
The Biological Laboratory
Cold Spring Harbor, N. Y.

ABSTRACTS

GENETICS

Social Implications of the genetics of man, A. H. Sturtevant. *Science* **120** (1954), pp. 405–407.

Most of what is known about human genetics is derived by inference from other animals or from plants. Human mental differences are understood genetically only on the sensory level, as in color blindness; or on a pathological level, as in Huntington's Chorea. The more common individual differences in mentality have so far defied genetic analysis. From our knowledge of other organisms, however, "it seems safe to conclude . . . that any property as complex and as variable as this must have a large amount of underlying genetic diversity." This applies to individual differences and also to statistical differences among racial groups. We must be careful not to conclude from this that a particular, observed difference in behavior between individuals or between racial groups is genetically determined.

The presumed genetic diversity of races does not imply that one is better than another. "Society would do well to insure that as many people as possible, of as diverse racial origins as possible, get an opportunity to show what they can do to advance civilization. It may confidently be expected that individuals of various races will have the necessary genetic equipment to make unique contributions."

In the remainder of the paper the author discusses the dangers of low doses of radiation to which the entire world is exposed after each nuclear explosion. No exposure of the population is so slight as to be entirely safe. To a small extent it probably increases the likelihood of cancer in exposed individuals, and it certainly will result in an increment of defective individuals in future generations.

A morphological sex difference in the polymorphonuclear neutrophil leucocytes, W. M. Davidson and D. R. Smith. *British Medical Journal* **2** (1954), pp. 6–7.

For unfortunate individuals with intermediate sexual development, final determination of sex once required abdominal surgery, and then occasionally proved impossible. A better method, which involves searching for a Y-chromosome in dividing cells, is equally difficult. The method now made available can be used by any doctor in his office, although further trials are needed to prove its usefulness.

On the average, in every 38 white blood cells of women, one shows a characteristic drumstick-like projection from the nucleus. At least six such structures among 500 mature "neutrophil" cells constitute a reliable criterion of femaleness. Nothing exactly similar is found in male cells. The "drumstick" may represent the two X-chromosomes of females.

A rare human isoagglutinin anti-Tj^a and habitual abortion, P. Levine and E. A. Koch. *Science* **120** (1954), pp. 239–241.

In 1951 the blood of a 66-year-old cancer patient was found to contain an antibody (comparable to the antibody in some Rh-negative mothers) which destroyed any blood cells containing a hitherto unknown factor, named the Jay factor. In order to carry the antibodies without harm, the patient's blood must itself have lacked the Jay factor. Such a lack is apparently very rare, because among 5000 people tested, the only one whose blood lacked the factor and was compatible with the patient's was her own sister. However, the same antibody has since been identified in six other families, including one in Japan. With the exception of the two original sisters, who may have developed the antibody only in later life, no women with this antibody have been able to bear children. In women found to have the antibody during child-bearing age all of 18 known pregnancies have ended in miscarriages between the second and fifth months.

Blood group incompatibility of mother and fetus is known to result, frequently, in early infant death from erythroblastosis. That it can also produce early miscarriages has been suspected but not known. The rarity of this particular blood abnormality makes possible the inference of a causal relation between it and the abortions which occurred in the same patients. However, by itself this blood factor can explain only a small proportion of all spontaneous abortions.

Quintuplet and sextuplet births in the United States, J. B. Nichols. *Acta Geneticae Medicae et Gemellologiae* **3** (1954), pp. 143–152.

Seventeen quintuplet births have been recorded in the U.S., of which twelve are well documented. Most of these were very premature with one or more stillbirths, and only two were officially registered as quintuplet births. In only one instance are any of the babies reported

to have survived the neonatal period; of three live-born boys in this set, one died in infancy and the other two lived to maturity. In Canada, in addition to the Dionnes, there was one other set of quintuplets, of which none survived the neonatal period. There have been two documented sextuplet births in the U.S. Of one set, four survived to old age while of the other set one survived; the others all died at birth or in infancy.

Among the last 54,000,000 births in the U.S., during 18 years, there have been at least six quintuplet births, instead of the one quintuplet birth expected on the basis of Hellin's formula.

In 1895 Hellin observed that the frequency of triplet births was nearly the square of the frequency of twin births or 1/88²; quadruplets, the cube of the twin frequency. According to Hellin's formula quintuplets should occur about once among every 88⁴ deliveries, but the frequency given by the author corresponds to one quintuplet birth among every 55⁴ deliveries. This discrepancy may not be incompatible with Hellin's theory. It is conceivable that if early stillborn twins were as well reported as early stillborn quintuplets, twin births would be found to occur nearly as often as once in 55 deliveries. This is unlikely and, like Newton's gravitation, "Hellin's Law" may eventually be superseded by a more precise and meaningful theory.

The roles of heredity and environment in ontogenetic adaptation, F. E. Warburton. *American Naturalist* **88** (1954), pp. 51–56.

The author has drawn up two statements about the interaction of heredity and environment that go a long way toward clarifying the problem. The first is a refinement of the rather familiar principle that when environment is held constant, variation must be due to heredity, and when heredity is held constant, variation must be due to environment. In the author's words, "Many morphological types may develop in a given environment; which of these types will develop is determined by heredity. Also, many morphological types may develop within a given genotype; which of these types will develop is determined by the environment."

The second statement is more novel: "If two organisms of similar genotype develop in different environments, the morphology of each will be better adapted to the environment in which it develops than to the other environment, in many more cases than we would expect from chance alone."

The author explains the latter phenomenon by means of a simple mathematical "model." The most helpful illustration is perhaps the tanning of human skin. Normal Caucasian skin produces pigment at a relatively low rate if not exposed, but responds to sunlight by an increased rate of pigment production. The dependence of the rate of pigment production upon exposure to sunlight is a hereditary trait, developed under the influence of natural selection and therefore advantageous or "adaptive."

Experimental studies on the distribution of gene frequencies in very small populations of *Drosophila melanogaster,* S. Wright and W. E. Kerr. *Evolution* **8** (1954), pp. 225–240.

The authors studied 108 colonies of fruit flies, each consisting of eight parents selected at random in each generation. Each colony was started with equal proportions of a dominant gene for an eye defect and of the corresponding normal gene. Although the eye defect constituted a serious handicap, strongly opposed by natural selection, it became "fixed," or ubiquitous in three of the colonies within ten generations, at which time the normal gene had become fixed in 95 colonies. This result is close to mathematical expectation and furnishes experimental support for the theory that, in addition to natural selection, "genetic drift" or random fluctuations of gene frequencies may influence the course of evolution.

The chromosome constancy of the normal mammalian uterus, Leo Sachs. *Heredity* **8** (1954), 117-124.

(Normal human beings all have 48 chromosomes or 24 chromosome pairs in the cells that give rise to sperms or eggs. Geneticists generally assume that cells in other parts of the body, "somatic cells," also have 48 chromosomes each, with certain well-known exceptions. The discovery in somatic tissue of many cells with less than 48 chromosomes would have important and disturbing implications for genetic theory about cancer, embryological development and identical twins.)

The lining of the human uterus is one of the most favorable somatic tissues for the study of chromosome numbers. Some recent investigators have reported that most of the cells in this tissue contain less than 48 chromosomes. In the present study uterine cells were all found to have the normal number, and this was true both in human subjects and in two species of laboratory animals. The author supports the view that cell multiplication and tissue growth are carried on almost exclusively by cells with a normal complement of chromosomes, and that cells acquire chromosomal abnormalities, as in

the liver, only after losing the power of multiplication. Even these degenerate cells do not usually have *less* than 48 chromosomes in man.

Genetic aspects of multiple sclerosis, Ragnar Müller. *A.M.A. Archives of Neurology and Psychiatry* **70** (1953), 733-740.

Two previous systematic searches for affected relatives among patients with multiple sclerosis have indicated that some families may have a genetic predisposition to the disease. A twin study, on the other hand, revealed no instances of concordance among 14 monozygotic pairs, 9 of whom were over 40 years old. The author investigated 750 patients and found the disease in only 0.6 per cent of observed relatives over 9 years of age. The highest incidence, 2.3 per cent, was for the patients' children, and this figure is only twice its standard error.

Although the risk of multiple sclerosis would seem to be a little higher in relatives of patients than in the general population, the frequency in the population is not accurately known. The author concludes that present data do not support a genetic explanation of the disease, and that even if genetic influences are involved, their effect must be regarded as relatively unimportant.

GORDON ALLEN, M.D.
Research Branch
National Institute of Mental Health

POPULATION

Community conditions and psychoses of the elderly. Ernest M. Gruenberg. *The American Journal of Psychiatry* **110** (1954), pp. 888–896.

This is a progress report on a research project sponsored by the New York State Mental Health Commission of which Dr. Gruenberg is Executive Director. Briefly described, the design of the study involved: (1) the selection of Syracuse as the community to be studied. (It met the requirements of being sufficiently large, being regarded as fairly representative of U.S. cities of its size, having census-tract data, and disposed toward cooperation with the study); (2) The search of records of first admissions for cerebral arteriosclerotic and senile psychosis in mental hospitals in New York State and the allocation of those from Syracuse to proper census tracts; (3) computation of census-tract rates of first admissions; and (4) correlation of first admission rates with the independently derived social and economic characteristics of the census tracts.

As for findings the "evidence indicates that there is in the center of the city an area characterized by high first mental hospital admission rates for cerebral arteriosclerotic and senile psychosis, by high first mental hospital admission rates for all the other psychoses taken as a group, by high concentrations of multiple family dwellings, and by high percentages of people living alone." The author suggests several points for further investigation in order to help clarify cause and effect relationships.

World population and resources. Prepared by a Study Group of PEP (Political and Economical Planning), 16 Queen Anne's Gate, London, S.W.1, England. (1954) English Version, 28 pp.; French Version, 32 pp.

This dual-language pamphlet is described as "a reprint of a broadsheet No. 362 in the PEP series PLANNING, published on 26 April 1954." Its aim is that of "reducing to the simplest possible terms this vast, complex and serious world problem [of population and resources], whose very magnitude has led to its being generally ignored or misunderstood" (p. 24.) It gives the familiar story of the upsurge in world population since 1650 and discusses past and prospective trends in food resources, fuel, power, and certain raw materials.

According to this report, "World food production is at present growing at about 2 per cent yearly and world population by roughly 1.3 per cent. From this it appears that the average man is getting rather better fed. If these figures are analyzed, however, it proves that much of the increase of food production is in countries which already have enough to eat but are not considerable exporters, while much of the population increase is concentrated in regions which are not achieving corresponding increases in food production, nor able to import more food and which were already among those having the highest proportions and numbers of underfed people" (p. 18).

PEP offers no recommendations in the present report. An additional broadsheet and a final and more detailed report on the subject are planned.

Correlates of values about ideal family size in the Detroit metropolitan area, Ronald Freedman and Harry Sharp. *Population Studies* **8** (1954), pp. 35–45.

The interviews taken in 1952 with a cross-section of the adult population (over 21) of the Detroit Metropolitan Area, included the following question: "People have different ideas about children and families. As things are now,

what do you think is the ideal number of children for the average American family?"

The total sample consisted of 749 persons and the reply for 8.8 per cent of these was entered as "not ascertained."

Among those replying, 91 per cent mentioned two, three, or four as the ideal. Those mentioning "none" and "one" as ideals collectively constituted only 2 per cent, those mentioning "five" formed 3 per cent and those giving six or more as the ideal number formed only 4 per cent. All percentages given above are virtually the same as those resulting from similar inquiries made by the American Institute of Public Opinion and relating to the total United States for the years 1941 and 1945. However, because of shifts in proportions mentioning "two" and "four" as ideals, the mean ideal for the 1952 Detroit Survey is higher than that for U.S. 1941 but lower than that for U.S. 1945.

"The differentials by education, place of rural experience, religion, age, and income of family head are usually consistent with our expectations. They correspond with traditional differentials found for actual fertility patterns" (p. 40). The correlates reported upon included neither sex nor marital status of the respondent.

The theory of complementary needs in mate-selection: an analytic and descriptive study. Robert T. Winch and Thomas and Virginia Ktsanes. *American Sociological Review* **19** (1954), pp. 241-249.

"The basic hypothesis of the theory of complementary needs in mate-selection is that in mate-selection each individual seeks within his or her field of eligibles for that person who gives the greatest promise of providing him or her with maximum need-gratification. . . .

It follows from the general motivational theory that both the person to whom one is attracted, and the other being attracted, will be registering in behavior their own need-patterns. Then a second hypothesis follows from the first—that the need-pattern of *B*, the second person or the one to whom the first is attracted, will be *complementary* rather than *similar* to the need-pattern of *A*, the first person" (p. 242).

When one considers that marriage itself is the institution built up to accommodate the primordial complementary sex needs of man and woman, the hypothesis hardly seems to partake of the unexpected. On the other hand, so much has been wrtiten about the importance of *similarity* of interests in successful marriage that it is well to have a study of the role of *complementary psychic* needs in mate selection.

The authors report the results of a preliminary study based upon "a reasonably random sample of 25 native-born [*sic.*] persons who were undergraduate students in selected schools at Northwestern University in 1950 and their spouses, or a total of 50 persons" (p. 245). Some of the "needs" considered were abasement, achievement, approach, autonomy, deference, dominance, hostility, nurturance, recognition, succorance, status aspiration, and status striving (p. 247). The method of study involved (a) a "need-interview," (b) a case-history interview, and (c) an eight-card thematic apperception test.

The authors state that the results based upon their preliminary small sample are by no means perfect, still "it appears that persons like our subjects tend to select mates whose needs are complementary rather than similar to their own" (pp. 245-248). The authors plan further analyses.

The demographic evolution of Belgium, Fernand Hebette. *Population* **9** (1954), pp. 85-104.

The author, a member of the Ministry of Economic Affairs in Brussels, states that an increasing proportion of the Belgian public is becoming interested in the demographic situation of that country.

Before the war Belgium was in average position among neighboring countries with respect to level of her birth rate; she has lost this position and is regressing appreciably. Some resurgence of fertility was experienced during the last years of the war and in the immediate post-war period, but this was largely a recuperation of the previous losses. In more recent years, except in 1952, fertility has declined.

The author utilizes quite refined measures of fertility such as fertility rates by calendar year, order of birth, and duration of marriage. His results lead him to the conclusion that the classical "total fertility" ("taux de reproduction") does not reflect the fundamental fertility situation. The author interprets his results to mean that despite short-run favorable factors, marital fertility rates in Belgium are not high enough to ensure the replacement of generations. In addition, there is a marked trend toward aging of the population. In 1950 about 16 per cent of the population of Belgium was 60 years of age and over; in 1970, the proportion will be about 20 per cent according to estimates of Bougeois-Pichat cited by the author.

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